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Children Attending the Public Day-Schools for the Deaf

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Chicago Public Schools

A Special Report of the Department of

CHILD STUDY

AND

PEDAGOGIC INVESTIGATION

ON

Children Attending the Public Day-Schools for the Deaf in Chicago

D. P. MacMILLAN, Ph. D.,
Director

F. G. BRUNER, Ph. D.,
Assistant

CHICAGO NEWSPAPER UNION, CHICAGO

An Enlarged and Revised Edition of a Preliminary Report Submitted to the Board of Education and Printed on May 25, 1906

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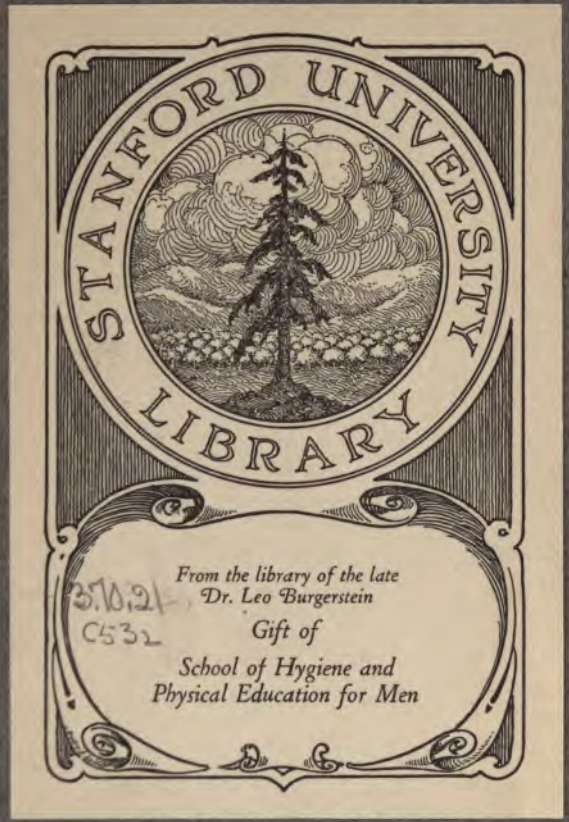

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CHICAGO PUBLIC SCHOOLS

A SPECIAL REPORT OF
THE DEPARTMENT OF

Child Study and Pedagogic Investigation

ON

CHILDREN ATTENDING THE
PUBLIC DAY-SCHOOLS FOR
THE DEAF IN CHICAGO

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LETTER OF TRANSMITTAL.

Chicago, October 12, 1908.

Mr. E. G. Cooley, Superintendent of Schools—

Dear Sir: I submit herewith a report on the deaf children of the public schools of Chicago, and ask that a sufficient number of copies be printed at the earliest convenience. The subject-matter has been on our hands now for a long time, and on account of the large number of requests for the information collected by us, as well as the intrinsic interest and value of this data for our teachers in service, I believe the whole subject ought to be put in available form for use.

An account of our dealings with the special study of the deaf children is given in a formal way in this letter of transmittal to you.

The attention of the Department of Child Study and Pedagogic Investigation was first officially drawn to deaf children in the public schools of Chicago by action of the Board of Education at the opening of school in September, 1902. At this time the Superintendent of Schools placed the matter before the Committee on School Management, and on September 3, 1902, the minutes of the Board indicate the following course of action:

"The Committee on School Management reports that there are in the School for the Deaf Mutes quite a number of children who might be more properly taken care of in the schools for the feeble-minded. As the task of separating the feeble-minded from the normal children in these schools is a delicate one, the committee recommends that the Superintendent be authorized to employ the teachers in the Child Study Department to aid him in determining whether they should be excluded from the public schools or not." (Proc. 1902, Page 70.)

A report on these children was submitted to the committee on October 2, 1902, which showed that a psycho-physical examination had been given to 160 pupils in the rooms for deaf children, among whom were found 16 children who were noticeably or markedly subnormal in mentality and were accordingly

recommended for exclusion from the public schools. Since that time it has been the policy to have each child undergo a psychophysical examination by the Department of Child Study, as soon as the parents of the child make application for his admittance to these rooms for deaf children. In two or three instances the Supervisor had been prevailed upon to admit to these rooms, when the classes were exceptionally small, certain children who were practically deaf for ordinary school exercises and afflicted with speech defects, for the reason that they would gain exceptional benefit from the kind of training which the teachers of these children alone could give.

On account of the time-worn contention among parents of deaf children as to the relative superiority of the lip-reading or oral and the manual methods of teaching the deaf, and especially as to the alleged non-adaptability of the oral method to any children except those of more than ordinary brightness, and to those with some power of hearing, it so happened that the whole matter was again brought before the Committee on School Management at the beginning of the school year 1904-1905. No definite action was taken by the Board until the following communication was received October 26, 1904, from one of its members which finally was effective in bringing about the more comprehensive and formal report herein embodied.

" . . . Since the last meeting I have visited several deaf and dumb schools, and I found them very much neglected. In one case I found two children who were not deaf or dumb, and had no right to be placed with these children. I also found at least thirty or forty per cent of the children under normal, as well as deaf and dumb, and was informed that teaching these children the oral system was a waste of time on account of their impaired mental condition. I also found teachers with classes so large that it is impossible for one teacher to make progress with all the children—naturally more attention was given to the brighter children and the others were neglected. Therefore I think it the duty of this Board to thoroughly investigate the entire matter and where there are children who cannot learn the oral system, the combined alphabet or the sign system should be taught in special rooms in schools other than where the oral system is

taught. I also think more time should be given to the teaching of reading, writing and arithmetic, as these studies seem to me to be the most essential to a deaf and dumb person. . . I trust your honorable body will give the matter the most thorough consideration and investigation, as this department of the public school system is much neglected and should have a thorough reorganization, better rooms, more teachers and more attention in general given to the children afflicted by the loss of hearing and speech."

On January 18, 1905, a committee consisting of the Superintendent of Schools, the Director of the Child Study Department and three medical inspectors was appointed to investigate the whole matter and to report its findings to the Board of Education. In accordance with the usual routine of such matters the whole inquiry was referred by the Superintendent of Schools to the Department of Child Study and Pedagogic Investigation, and on April 12, 1905, a brief summary of the results was submitted in a preliminary report. The only action taken on the matter at this time was to refer it back to the investigators with instructions to present the data in detail. The final report herein submitted was placed in the hands of the Superintendent of Schools, subject to call from the Committee on School Management, which demand finally was made on May 25, 1906, whereupon it was ordered printed at once, and copies distributed among the members of the Board of Education and educators of the city.

The original form in which it was printed by the Secretary of the Board was, in certain features, abbreviated and popularized and as such it fulfilled a temporary and local service, but owing to the large number of requests for copies and inquiries from school boards of other places, from educational governing bodies and from professional and general libraries in this and other countries, as well as the desirability of placing our results in permanent form for our teachers, it seems highly advisable to print the whole subject-matter in a form which will more adequately meet the larger demand.

Very respectfully yours,

D. P. MAC MILLAN, Director.

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EXPERIMENTAL STUDIES OF DEAF CHILDREN.

It is doubtful if more than a very small minority of persons who have not had intimate dealings with deaf children are familiar with the characteristics which differentiate this special group from hearing children. One meets with all sorts of opinions and notions concerning their capabilities or incapacities. It is held by some that the senses of deaf children, other than hearing, are exceptionally acute, and again the assertion is made that children who are defective in one sense are deficient in all the senses and for this reason they speak of the mind of the deaf child as of a distinctly lower type.

This study is not, indeed, concerned with all the deaf children in Chicago, nor with all deaf children of school age. It deals with deaf children attending the public day schools whom this department considered of high enough grade of mentality to be educable by the special class methods of the public schools for the deaf. These deaf children have been admitted into these special rooms of instruction upon recommendation, after being subjected to a careful psycho-physical examination to determine their mental status and the degree of hearing power which they possessed. The feeble-minded and those of extreme sub-normal mentality are not incorporated in our results. It was, then, our object to carefully examine and estimate the comparative physical and mental status and to make an extended study of the progress and school conditions of the deaf children in the public day schools of Chicago.

Some three months were devoted to this study. Children were taken in groups of two or three in a private room in which conditions were similar to those of the classroom, and in all about one or two hours was given to each child. This length of time was found necessary on account of the difficulty of getting responses from this class of children, who are naturally so excessively timid and hesitant in manner. This it is natural to

expect on account of the difference in their social life, which is usually confined to intercourse with parents, teachers or children similarly afflicted. Experience has shown that one must have at least a half-hour's intimate association with any child before he can be reasonably sure that the responses secured are anything at all like normal, and that the estimate made of the child's mental efficiency is not totally erroneous. If this be true of children in general, it is so true as to be axiomatic when deaf children are the subjects of examination. To estimate the mental status or educational possibilities of the deaf child requires not only special knowledge of their habits and characteristics, but also considerable intimacy with their environment and social conditions. A cursory examination will very frequently lead one to adjudge a child as of sub-normal mentality, whereas a greater familiarity with the disparities and mental traits of this class of children will enable one to secure surprising results. It was found advantageous, in order to overcome the reticence of these children, to make the first examination brief and preliminary, so that the children might become personally acquainted with the examiners and confident in all their modes of expression.

In order to investigate the hearing and speech possibilities and progress of deaf children, it is indispensable that we have some knowledge of the sensory, nervous and bodily conditions which are intimately related to both hearing and speech. Thus, it is necessary to know something of the sight, as good vision is necessary to good lip-reading. It is necessary to know whether the defect in hearing is local or whether it is due to general lack of sensitiveness. Likewise it is of value to know whether the deaf child is less or more sensitive to impressions of touch, weight, etc. In case these senses are obtuse, one might well conclude that the deficiency in aural acuity is primarily due to general dullness of the whole psychical system. If the other senses are acute, the defect is probably due to the organ of hearing and not to obtuse mentality. To acquire speech it is of the first importance to have good organs of speech. The nose and throat must be open and free. The naso-pharyngeal cavity must be examined for enlarged tonsils and adenoid growths. Something must be known of the hard and soft palate in their

relation to middle-ear deafness and breathing power, as well as the condition of the tongue, both as to structure and mobility. The general nervous condition of children very markedly influences their speech and mental ability. The same nervous conditions which induce such defects as stammering, stuttering, hesitancy, lisping and lalling are as likely to occur in deaf children as in hearing children. Then, too, there are such nervous affections as chorea, nervous inertia and general incoordinations. These especially influence mentality and speech.

The report of the Child Study Department for the year 1899-1900 showed that those children who were larger, stronger quicker and better nourished were mentally superior to those who were not so well developed. The same conditions which favor physical superiority are found to have a like or comparable influence on the mental side. It therefore to a degree not only affords a convenient but a serviceable cue to the mental status, to know how deaf children compare in size, strength, quickness, sensory and motor defects with hearing children of the same age. In the case of a child having no language, it is difficult to gain much information directly of his mental ability. It is, however, possible to measure his efficiency in such simple processes as perception, and, in case a child possesses a few symbols, it is possible to learn something of his immediate sense memory. It was our aim to employ only simple tests to study all these various phases of the sensory, physical, nervous and higher mental life of these children, in order to secure cumulative evidence of the exact nature of their hearing defects and of their mental and physical conditions as these are related to the acquiring of speech and school training.

HEARING.

METHOD OF CONDUCTING THE TESTS.

Three instruments were used in the examination of hearing power:

First: The Audiometer. The instrument used was an ordinary Seashore audiometer. This is, in brief, a simple electrical apparatus for producing a measurable noise which is brought about by the making and breaking of a secondary current. This noise is transmitted to the ear of the person tested

by a telephone receiver held tightly against the ear. The child is tested with his back to the examiner and with eyes closed. The instrument was devised for testing differences in aural acuity of persons not ordinarily considered defective in hearing. In many cases its range is too limited for grading hearing power when this power is not of sufficient acuity to detect speaking tones of the human voice. The hearing power of children can be conveniently graded according to the norms for hearing acuity, worked out with normal children and already reported on. (See Report No. 2, Department of Child Study and Pedagogical Investigation.)

Second: "Snapper." This little instrument when snapped between the forefinger and thumb, makes a mechanical snap of sufficient loudness to be heard by the human ear of average acuity in a quiet medium at a distance of about 500 feet. It is held by the experimenter slightly behind the ear of the child examined, out of range of vision either direct or lateral, and the child is asked to count the clicks, or in case of the younger children, the starting of the body entire, and the superficial reflexes, especially the conjunctival, are observed. By this means the hearing power of certain children could be gauged who could not be reached by the more delicate instrument.

Third: Differential Tube. This piece of apparatus consists of a tube of soft rubber whose internal diameter is 4 mm. and whose length is 100 cm., fitted with hard rubber ear pieces to be inserted into the ears, one end into the child's ear and the other into the ear of the examiner. This ear piece was held firmly between the first finger and the thumb, and care was taken that the stimulation was not communicated through the sense of touch. A tuning fork of pitch "*a*" was struck on a hard substance and its base applied to the tube. First, in order to familiarize the child with the sound, the fork was struck briskly on a hard object and its base placed on the child's front teeth. Only after the child became somewhat familiar with the sound thus conducted, was recourse had to air conduction. This instrument proved adaptable for testing hearing power of even lower grade than the snapper, owing largely to the fact that the stimulus had a greater duration, thus affording a better opportunity for e element of attention to enter.

This work with instruments was further supplemented by tests made with the human voice in ordinary speaking tones and in shouting, taking care when within close range that the child was made as nearly as possible dependent upon the sense of hearing.

CLASSIFICATION.

The hearing ability of this group of children somewhat conveniently is divided into five classes. This division is purely conventional and practical inasmuch as it is formulated wholly on the basis of school room efficiency and the value which must be attributed to the power of hearing in its relation to the acquisition of oral speech.

In the first column, Class 1, are shown the pupils who are totally deaf—insensitive to the strongest sound vibrations which we had any means of employing.

In the second column, Class 2, are presented those who are practically deaf, i. e., only sounds which are continuous and most intense can be heard. It is very probable that their hearing can never be developed sufficiently to hear the human voice even with the assistance of mechanical devices.

In column three, Class 3, is given the number of those children who possess a degree of hearing power—they hear loud sounds, but yet they have not sufficient sensitivity and control of hearing to understand vocal speech. The children of this class offer hope that with the assistance of mechanical devices for intensifying the voice, their hearing power may be developed so that advantage may be taken of this normal means of acquiring spoken language.

Class 4. Those pupils who are deaf for ordinary school conditions, are placed in column four of the table. In general, the pupils of this class hear only words spoken loudly and close to the ear and are therefore to be considered as deaf from the point of view of conditions that ordinarily prevail in the schoolroom. They do, however, possess sufficient hearing to assist them in acquiring speech when appeal is made to their understanding through this sense avenue.

In column five, Class 5, is listed a certain small number of hearing children who were temporarily in the rooms for the

deaf and who are greatly in need of the training in articulation which it is not possible for them to get in our school system, except from teachers who have had special training in the rudiments of voice culture.

TABLE I.

POWER OF HEARING.

Schools	Class 1. Totally Deaf	Class 2. Practically Deaf. Hear only most intense continuous sounds	Class 3. Hear loud noises but cannot hear speech	Class 4. Deaf for ordinary school purposes	Class 5. Hearing children. In deaf rooms for speech training
Holden	2	1	2	5	0
Beidler	2	0	0	1	0
Burr	5	1	7	2	2
Clarke	2	2	4	1	0
Darwin	10	4	8	3	2
Dore	1	2	0	6	1
Froebel	4	1	0	1	0
Hammond	3	2	3	0	0
Kozminski	1	1	4	0	0
Normal	2	1	3	1	0
Ogden	7	8	5	0	1
Seward	4	2	0	1	0
Yale	11	8	17	5	2
Totals	55	33	53	25	8

Total number examined.....174

Although thus classified, it must not be assumed that these children will always retain the exact relative order here presented. With some the hearing power deteriorates, while the hearing power of others will show marked improvement owing to their general mental training in giving attention and in attaching significance to excitations of this sense organ. Even among those congenitally defective in hearing it must not be assumed that the hearing power will always remain stationary. Some children were in the deaf rooms who were regarded as born absolutely deaf and now at the age of fifteen or sixteen are able to hear conversation. This improvement usually accompanies the great growth changes at the periods of second dentition and of puberty. There are certain children with varying degrees of deafness whose hearing has gradually improved; there are other cases of deafness in which there is apparently no improvement. The congenitally deaf, however, form, as far as we are able to determine, only about 50 per cent of the total number, but it is difficult to draw a hard-and-fast line of demarkation between congenital cases and deafness as one of the

sequelæ of disease. Many parents assign very insignificant causes for this affliction. In many other cases it is impossible to determine just when deafness did occur, especially since scarlet fever, spinal meningitis and other febrile diseases sometimes are experienced during the first year of the child's life before speech develops, and deafness is attributed to these, whereas as a matter of fact, it antedated them. The two most frequent maladies which leave deafness as one of the sequelæ in their wake, as suggested above, are scarlet fever and spinal meningitis. The significance of this is manifold in that very frequently some tendency to mental aberration is also present, together with nervous disturbances and inco-ordinations. Although not feeble-minded always, these children so afflicted would be far below the normal in mentality even were their hearing normal. It is a matter of observation that deafness which occurs as a result of disease is as frequently attributed to some catarrhal condition of the middle ear, atrophy of the ossicles of this region, or degeneration of the typmanic membrane, as to some internal ear trouble or lesion of the brain. Sometimes these diseases cause absolute loss of hearing. In other cases there is but slight diminution in auditory acuity. In every case it is very desirable to know just where the defect lies, as well as the degree of deafness, in order to classify the child and suit his school training not only to his present status but also to his future needs.

Reference to Table I will show the relative proportion of children in each of the five classes. In the first class there are 55; in the second, 33; in the third, 53; in the fourth, 25. Were the number examined very large, extending into the thousands instead of 178, we might reasonably expect to find an equal number of children in each class; that is, experimental evidence goes to show that there are varying degrees of deafness, ranging all the way from slight and temporary impairment of hearing due to a cold, to the stage of absolute and permanent silence. This, of course, necessitates some practical standard by which one must judge whether a child's hearing is sufficiently poor to justify his being assigned to the the rooms for the deaf. Where the recommendation has been made by the Child Study Department, the criterion has been a practical one, based not

alone upon the child's absolute power to hear, but also upon his inability to carry on the work successfully in the rooms with hearing children. However deaf a child might be, he was never recommended for the deaf classes as long as his progress in the rooms with hearing pupils was satisfactory. Likewise in those cases where the defect was more largely one of mentality instead of defective hearing it has been the policy of the Child Study Department to recommend that the child be excluded from the rooms for the deaf. The above criterion seems the only one usable in actual practice.

Among normal hearing children, speech is an instinctive acquisition which shows itself at a relatively definite time in mental ripening. The activities and speech of all persons in the home are a constant appeal to the young and yearning listener, and so there come to be set up mental associations between his acts of hearing and his vocal responses. The activities of seeing, hearing, touching, etc., which at first operate somewhat independently of each other, come to be firmly and constantly connected, so that one sense organ-act stands for the activity of another sense-process or group of such processes. Seeing comes to stand for touching. Hearing means doing or going to do. The child hears his own prattle as well as the speech of others about him. Others attribute meaning to his spontaneous babblings and his special acts, and, in the initial steps at least, his acts are named for him. These activities in which he indulges and to which others give specific values and names, are at first gross and inchoate, with meanings as vague, but gradually become with his growth of consciousness, more definite and precise. In this way a certain word or name heard is associated with some object reacted upon and the child's natural babblings are made to conform to the word heard. Thus the child, through his own hearing and with very small effort, catches the cues which lead to his articulation of the words he has heard spoken by those about him. But with the deaf child, the process of acquiring speech is by no means so simple. No sounds are heard, or if sensed at all, are heard very indistinctly, so that the procedure becomes one in which intense and concentrated attention is necessary to succeed at all.

The most direct inherited associations are between speech and hearing, and not between speech and sight, as must be the procedure in the case of those whose power of hearing is absent or very defective. It is always very difficult to divert nature's course, but this does not imply that it is never advisable as exigencies arise to modify her laws or methods of procedure. When limitations have been set to one group of associations, it is absolutely indispensable to form a new set of associations if training of any part is to take place, and this re-direction of an instinctive procedure is not accomplished without considerable effort. Intercourse between individuals is possible only by some language medium, and a language medium implies some sort of symbols which refer directly to objects, activities or events, and it further implies that the symbols used have a common meaning to all using them.

All articulatory symbols of intercourse are relatively arbitrary and conventional, and their expression must occur either, as is commonly the case, by the natural way of imitating with the vocal mechanism what is received through the auditory apparatus—in which case the symbols are expressed spontaneously—or the meaning of these symbols must be consciously acquired and their expression laboriously worked out, as in the case of the deaf. In the latter there must occur a definite adjustment of mouth-parts and chest activity on the one hand, or the manipulation of the hands on the other, according as the vocal or manual language is used. One must be learned as well as the other. The selection and preference of one method over another, must be decided on other than psychological grounds, inasmuch as psychology properly defined, deals with a description and explanation of all mental processes, and so every mental reaction, the true and serviceable as well as the false and trivial, must have its history as to its origin, characteristics and function. Both utility in social relations and facility or ease of acquirement must largely determine whether one or the other method of training the deaf shall be used in the schoolroom.

There is the further question as to whether the manual method has certain limitations as compared with the oral in

developing the mind. But this is a question that must be decided, for the present at least, on theoretical and philosophical grounds. Thus far there have been no scientific investigations on adults, trained by these two methods, which might tend to show that the range of expressive thought is greater or less in one method than the other. The philosophical problem is one that does not concern us here, for it leads to nothing more than the expression of an opinion, and offers no hope for the solution of the question.

SPEECH.

There are found in the rooms for the deaf, children who had no speech when deafness occurred. There are others who had learned to speak a little, and again, there are a few others whose deafness appeared after five years of age and who possessed considerable power of speech. It obviously would not be just to group all these together. Therefore the children are distributed into three groups on the basis of their capacity for appreciating and using speech, taking into account the time they have been receiving instruction. We have then as a mater of fact the following groups: (1) those whose speech is normal or nearly so; (2) those whose speech is defective either in the quality of tone of the vocal sounds or in the articulation of the consonants, nasals, labials, sibilants, etc.; and (3) those who have no speech or are incapable of uttering intelligently at least fifty words. Of course all children who had lost their hearing before they had learned to talk would be in group 3 on first entering school.

The problem, then, is that of determining the character of the speech that has been acquired for the different periods that the children have been in school. In keeping with this, the children in the various rooms have been distributed according to their efficiency in speech after they have been in school three, five, seven and ten years. It must be borne in mind that these groups do not include all the children in the rooms for the deaf, since obviously there is a large number of them who for various reasons have not been in school for as long a period as three years. Furthermore, not only must the length of time the pupil has been in school be considered but also his conditi

on entrance into school. Under those three groups, therefore, of children whose speech is normal, whose speech is defective, and those whose speech is practically wanting, it was thought advisable to indicate the following (See Table II, p. 19):

I. Children who have sufficient hearing to assist them in acquiring speech.

II. Pupils whose hearing was lost after the age of five years—i. e., after quite a degree of facility in speech had been gained before deafness occurred.

III. Pupils who lost hearing before five years of age—i. e., where an opportunity had been afforded for the loss of auditory imagery and the fading of muscular habits associated with articulation and phonation.

IV. Those born deaf, or those in whom the loss of hearing occurred so early in life that speech had never been acquired.

THREE YEARS IN SCHOOL.

Of deaf children who have had speech training for no longer than three years, we can make the following summary:

24, speech normal, or nearly so.

23, speech more or less defective—i. e., have considerable speech, but the articulation or tonal quality of the voice is more or less defective.

7, speech wanting—i. e., from the practical standpoint, little or no speech.

It must be understood that where speech is herein spoken of as more or less defective, the child can usually be easily understood by almost everybody, and in all cases can be understood by those who are accustomed to associate with him, though his voice, to be sure, is unpleasant and unnatural.

Of these twenty-four whose speech was found to be normal, it is interesting to learn that six children possessed some usable remnants of hearing, while 18 were deaf. Of the 18 deaf at least 10 had lost their hearing after the age of five years, leaving only 6 who were afflicted with deafness before the age of five and 2 congenitally deaf. That is, we may say, that normal speech had been taught to 8 of the 54 children by the indirect method during the brief period of three years.

Turning to the 23, whose speech was understandable but

somewhat defective, the data show, that 3 had some hearing and 3 had lost their hearing after the age of five, 9 deaf children had lost their hearing earlier than the age of five and 8 were born deaf.

Of the 7 who possessed little or no speech ability after three years in school, none had ever had hearing to be of any service in the acquisition of an articulatory language, 4 having been congenitally deaf and 3 having lost their hearing early in life.

To summarize then if we exclude from consideration first, those who have sufficient hearing to assist them in acquiring speech and those who lost their hearing after five years of age, which two groups obviously form a separate class, we have remaining those who lost their hearing before the age of five and those who were born deaf. Of these we find:

8, normal speech.

17, speech more or less defective.

7, speech wanting.

FIVE OR SIX YEARS IN SCHOOL.

Turning now to the children who have been in school five or six years, we find the cases distributed as follows:

13, speech normal.

14, speech more or less defective.

0, speech wanting.

Considerable interest attaches to a comparison of the make up of the children of these three groups with those of three year school instruction. (See Table II.) Whereas, among the latter but 8 of 24 with normal speech had lost their hearing earlier than five years, or were congenitally deaf, of those with 5 or 6 years of school instruction, 10 of the 13 belonged to this class; all of those with somewhat defective speech had lost their hearing early in life; and no child of 5 and 6 years' school instruction was found without speech sufficient to communicate his simpler needs.

Again to summarize the results, excluding as above, that special class comprising those who have some hearing and those who lost their hearing later than the age of five, we have those

classified as born deaf and having lost their hearing before the age of five—of these there are:

10, speech normal.
14, speech more or less defective.
0, speech wanting.

SEVEN OR MORE YEARS IN SCHOOL.

Taking up those children who have been in school seven or more years, we find the following distribution. (See Table II.)

13, Speech normal.
9, Speech more or less defective.
0, Speech wanting.

One boy among those with normal speech had hearing and was temporarily given a place in the rooms for the deaf to remedy his very defective articulation. Of the remaining 12, only 2 had lost their hearing later than five years, 2 were deprived of their hearing before the age of 5 and 8 were congenital cases.

One only of the 9 with somewhat defective speech had lost his hearing later than 5, 3 before the age of 5 and 5 had been deaf from birth.

TABLE II.

ABILITY TO USE SPOKEN LANGUAGE.

Table showing the power of speech possessed by children of different degrees of deafness, who have received speech training for three, five, seven, and ten years respectively.

Character of speech	Time in school	Hearing sufficient to aid in acquiring speech.	Deaf		
			Hearing lost after the age of five years	Hearing lost before the age of five years	Congenitally deaf
Speech normal, or nearly so.	3 years	6	10	6	2
	5 or 6 years	3	0	7	3
	7 years	0	2	2	5
	10 years or more	1	0	0	3
Speech somewhat defective, either in quality of tone or articulation of sounds.	3 years	3	3	9	8
	5 or 6 years	0	0	4	10
	7 years	0	1	3	5
	10 years or more	0	0	0	0
Speech wanting, or less than 50 words	3 years	0	0	3	4
	5 or 6 years	0	0	0	0
	7 years	0	0	0	0
	10 years or more	0	0	0	0
Totals		13	16	34	40

Taking into consideration then the acquirement of speech as it is related to time of instruction, we find of the whole number of 103 children who had had at least three years school training,

that 96 succeeded in acquiring oral speech, of whom 50 possessed normal speech and 46 were able to interpret oral language, but to speak albeit with difficulty or slight defect. It will be seen, moreover, that of this whole number there are 13 children who possessed sufficient hearing to enable them to be materially assisted in acquiring speech under schoolroom conditions. Of the children who must be classed as deaf, 16 lost their hearing after the age of 5 years; 34 were deprived of their hearing before the age of 5 years, while there are 40 whose parents gave evidence regarding their early lives which indicated that in all probability these children were born deaf.

Although 7 children were found whose speech was wanting after a period of training of 3 years, there were none after a school period of 5 or more years who were not able to express themselves more or less intelligibly.

Not considering those who lost their hearing later than the age of 5, and those who have considerable hearing, 23 had voices which were unpleasant and unnatural after three years of school training, 14 after five years and 9 after seven or more years. These comparisons are made with reference to the voice of the normal child as a standard and are obviously unfair to a child working under the limitations of the deaf. It would no doubt be better to use a criterion of practical utility rather than one of esthetic value, but it is impossible in the case of the former to arrive at any norm for comparison, and hence we are forced to the use of the apparently less practical standard of reference, which, nevertheless, has, as a matter of fact, considerable significance.

The time that a child has been in school is not the only nor is it the most important, factor in effecting speech efficiency. The natural endowment of the child is an extremely important consideration. Next stands the environment, some of the most important factors of which are the character of the food which the child receives, and the regulation of his rest and exercise. It is further of significance whether the parents speak the language of the school and are thus able to give the child some drill in the exercise of his speech outside of school hours, or in case the parents do speak the language of the school, whether they have the time and inclination to thus co-operate with the

teachers. An attempt was made to evaluate all these factors in the study of the condition of each child, and formed part of the basis for the specific recommendations which were given to the child's teacher at the time he was examined with reference to his school possibilities and the best line of treatment adapted to his particular needs.

VISUAL ACUITY.

TABLE III.

VISUAL ACUITY.

Tables showing the distribution of deaf and hearing children, respectively, as regards the visual acuity of both eyes, whether the vision of the two eyes is the same or different.

DEAF CHILDREN.

Vision	1.00 or better. Normal	0.67 of normal. 20-30	0.50 of normal. 20-40	0.40 of normal. 20-50 or less	Blind
The vision of both eyes being..	225	35	21	2	0
The vision of one eye being 1.00, the other.....	.....	22	9	3	5
The vision of one eye being 0.67, the other.....	.....	.....	11	4	0
The vision of one eye being 0.50, the other.....	.....	.....	.....	1	5

Total number examined, 353.

HEARING CHILDREN.

Vision	1.00 or better, Normal	0.67 of normal. 20-30	0.50 of normal, 20-40	0,40 of normal, 20-50	0.29 of normal, 20-70 or le-s	Blind or nearly so
The vision of both eyes being..	972	82	11	27	69	0
The vision of one eye being 1.00, the other.....	.....	119	8	11	21	4
The vision of one eye being 0.67, the other.....	.....	.....	31	18	20	1
The vision of one eye being 0.50, the other	.....	.....	.....	11	7	0
The vision of one eye being 0.29, the other	.....	.....	.....	.....	24	0

Total number examined, 1,436.

The oral method of training the deaf implies not only the utterance of speech, but also speech-reading. With normal hearing children this is done through the medium of the ear, whereby even the slightest variation of tones and inflections are interpreted naturally and without effort, yet each carrying with it a significance that differentiates a shade of meaning.

Though the eyes are always used in discerning the attitude of the speaker by the hearing child, the use of these organs plays a subordinate role. Not so with the deaf child. Every idea communicated to him, except the few he gets through touch, taste

and smell, must reach him through his eyes. In interpreting speech he must observe the most minute movements of the mouth-parts, the eyes and facial muscles, to interpret their significance, translate them into ideas and observe shades of meaning by the slightest variations in muscular adjustments and movements. Hence the condition of the deaf child's vision becomes a very important consideration. While there are many opportunities for relaxation of the eyes of the normal child, these opportunities are obviously less frequent in the case of those children who have to depend on their vision almost entirely. Defective vision, therefore, tends to produce greater limitations among the latter than the former.

In Table III are given the distributions of deaf children and of normal hearing children, from comparable social environments and home surroundings, as regards visual acuity. In this the emphasis is laid on the function of vision as a determining factor in acquiring school information. It is well known that a child may have very defective vision in one eye and yet because the other eye functions normally, the child may not be seriously handicapped in receiving impressions from his surroundings. Accordingly the acuity of each eye is registered separately and the number of children is recorded who have good vision with both eyes as well as the number of those who are visually acute with one eye and defective in the other, or indeed, those who have poor vision with both eyes.

In the upper half of the table is recorded the distribution of 353 deaf children and in the lower half a similar distribution of 1,436 hearing children. Looking at the upper half of the table for a moment (the part referring to deaf children) it is seen that in the first line, beginning at the left, are tabulated; first the number of children with normal vision in both eyes (225); then the number whose vision for both eyes is 0.67 normal (35); 0.50 normal (21); and 0.40 normal (2), respectively. In the second line is shown the number of deaf children whose vision *for one eye only is normal,* while that of the other is 0.67 normal (22); 0.50 normal (9); 0.40 normal (3); and where the vision of one eye is wholly wanting (5). Then in the third line follows the number whose vision *in one eye is* 0.67 *normal,*

as registered from the vision chart, while that of the other eye is 0.50 normal (11); 0.40 normal (4); and vision entirely wanting (0). This will suffice to make the whole table easy of interpretation.

From the distributions in the table it is thus seen that of the total number of deaf children from whom we have visual acuity records (353) there are 225 or 63.7 per cent whose vision is normal as judged by the standards of the optician or occulist. Two hundred and sixty-four of the 353 or nearly 75 per cent have vision of at least one eye normal according to the same standards, and nearly 90 (88.9) per cent have at least one eye whose visual acuity is 0.67 normal.

It is of interest and significance to compare the visual acuity of deaf children with that of the 1,436 hearing children in the lower half of the table. About 3 per cent fewer of the deaf have the vision of both eyes normal. Four per cent fewer have vision of at least one eye normal, but almost 2 per cent more of the deaf have a visual acuity of both eyes 0.67 normal or better, as compared with their hearing companions. Certainly of considerable pedagogical significance is the fact, moreover, that the per cent of hearing children whose vision is very poor—0.50 normal or lower for one or both eyes—is nearly one-half greater than in the case of deaf children. Accordingly, it is clear that deaf children are not handicapped by visual defects, to any greater extent than are those children not afflicted with loss of hearing. By way of accounting for the relatively poor showing of deaf children among those whose vision is normal or nearly so, it is probable that resort must be made to some psychological explanation induced by the deaf child's inability to react to the test as efficiently as do hearing children. And owing to the paucity of numbers too much weight must not be attached to the apparently better showing of deaf children when comparing those whose vision is very poor. As much as can be asserted with confidence is that it is extremely probable in the light of the experimental data exhibited in Table III, that deaf and hearing children, on the whole do not differ as regards vision. A summary of the comparisons just made will perhaps show what has been said to better advantage.

Whole number of children: Deaf, 353; hearing children, 1,436.

		Number.	Per cent
Vision, 1.00 (20-20) or better. Both eyes	Deaf	225	63.7
	Hearing child	972	66.9
Vision, 1.00 (20-20) or better. One eye at least	Deaf	264	74.8
	Hearing child	1153	79.0
Vision, 0.67 (20-30) or better. Both eyes	Deaf	282	79.9
	Hearing child	1123	78.2
Vision, 0.67 (20-30) or better. One eye at least	Deaf	314	88.9
	Hearing child	1287	89.6
Vision, 0.50 (20-40) or less. Both eyes	Deaf	33	9.3
	Hearing child	188	13.1

In the foregoing statements of results and comparisons nothing has been said as to what constitutes defective vision. Of course it is well understood that defective vision from the educator's standpoint is quite a different consideration from visual defects as an oculist understands the matter. For instance, a child may have normal vision (20/20) in one eye, and the other may be only two-thirds, two-fourths, two-fifths, two-sevenths or even less in visual acuity. It will readily be granted even by oculists that if a child possesses sufficiently acute vision to be able to carry on his school work well he must be placed in a different category from those whose vision seriously impede their school labors. Very unfortunately the minimum degree of visual acuity that must be possessed to insure against eye strains, inefficient book- and black-board work, and certain physical ills which attend the functioning of weak visual organs, has not yet been determined. Indeed it is improbable that any hard and fast line can ever be set to mark off the functionally efficient from the inefficient eyes, and particularly not in terms of visual acuity alone. One frequently finds instances where the dioptric defect is seemingly grave, and yet the individual appears to see well and experiences no ill effects from the use of his eyes, and on the contrary a very slight irregularity in the organ of vision itself is frequently attended by very serious pains and strains. In the latter the trouble is induced by bodily or nervous depletion, primarily, and only secondarily is it to be attributed to irregularity in the structure of the dioptric media.

PHYSICAL CONDITION.

Besides the foregoing data on the comparative sensitivity of the sight and hearing of deaf children, and their acquired power of speech after definite periods of school instruction, it is of importance to gain some definite idea of their general physical condition.

Here again it is to be observed that so-called practical observations and verbal descriptions of differences between this group of children and normal children have always led to exaggerated accounts and unwise statements regarding the deaf, sometimes to their advantage, but more often to their disparagement. Therefore the more positive and precise are the statements and the greater variety of aspects of the physical make-up investigated, the greater is the hope of our understanding the exact conditions that must be encountered in attempting to educate these children into citizenship. It is on this account highly desirable to present certain quantitative statements of the physical status and deficiencies of deaf children as are evidenced in the two more or less, closely related aspects of physical growth, viz., *size or bulk* and *movement or control.*

In pursuance of this end, in the following tables are given the comparative stature, height-sitting, weight, lung capacity, maximum length and breadth of head, strength of hand-grip and voluntary motor ability, distributed according to age and sex throughout. (The greater number of cases (293) recorded in some of these tables is brought about by the fact that they include measurements other than these made during the period of this special investigation.)

STATURE.

The stature records represent the net heights expressed in millimeters. (See Table IV.)

It will be seen that deaf boys are not so tall on the average as normal hearing boys at any age with the exception of those at the age of 10 years, at which time a slight difference is in favor of the deaf boys. This exception may be accounted for by

a class of boys who had been receiving instruction and unusual physical training since their kindergarten days and who possessed especially favorable home surroundings.

The deaf girls before the age of 10 years are noticeably shorter than hearing girls and the differences are greater than the inferiority of deaf boys for their corresponding age—norms; but after this age the deaf girls are almost uniformly taller than their hearing companions. To be sure the numbers are small and the cases (75) of those years of apparent superiority may be exceptional in this respect, but the fact is indicative at least that for the deaf girls the disabilities which they experience in hearing or the causes of their affliction have not, during this span of years, impaired their growth as measured by their stature.

The height-sitting measurements show (Table V) that deaf boys are uniformly inferior throughout the years represented. The girls on the other hand are inferior up to the age of 11 years; at the ages 11, 12 and 13 they are taller sitting; at 14, 15 and 16 years they are again inferior, and thereafter the four cases show excess over the hearing girls.

Taking the deaf children as a whole and comparing them with hearing children with regard to stature it is found that only seventy-seven out of one hundred and seventy-seven, or 43.5 per cent, of deaf boys are equal to or above the average stature of hearing boys for equal age as against eighty-eight that would be found with the same normal hearing boys, and in height-sitting only sixty out of one hundred and sixty-seven boys, or 35.9 per cent, are equal to or above the average of normal hearing boys, instead of a possible eighty-three or eighty-four out of one hundred and sixty-seven in a normal group. Again we find only fifty-two out of one hundred and twelve deaf girls, or 46.4 per cent who are equal to or above the average statures for the normal hearing girls of their respective ages, and in height-sitting only forty-three out one hundred and ten, or 39.1 per cent, are equal to or above the average of hearing girls for the same ages represented. Both deaf boys and girls, consequently, it is learned, are not quite so tall as are hearing children of corresponding ages, and the deaf of both sexes have shorter bodies than do their hearing companions.

TABLE IV.

STATURE.

Age Yrs. Mos.	Boys				Girls			
	No. of cases.	Deaf children, average height. Millimeters	A. D.	Hearing children, average height. Millimeters	No. of cases	Deaf children, average height. Millimeters	A. D.	Hearing children, average height. Millimeters
6....6	10	1123.2	28.0	1132.5	9	1097.3	35.4	1125.1
7....6	23	1178.2	44.2	1183.9	15	1163.4	45.7	1182.2
8....6	23	1185.4	55.6	1234.8	14	1201.1	26.7	1227.5
9....6	18	1287.1	51.2	1288.0	7	1250.7	31.7	1277.4
10....6	20	1335.4	55.0	1330.3	12	1326.2	55.3	1324.1
11....6	12	1357.0	66.3	1371.9	7	1403.0	63.1	1383.0
12....6	14	1370.2	57.5	1418.9	8	1484.3	51.8	1443.2
13....6	15	1465.9	69.6	1490.9	11	1541.1	72.1	1510.4
14....6	12	1528.1	69.1	1547.4	7	1501.7	84.5	1562.4
15....6	13	1505.5	68.1	1614.1	11	1577.1	61.9	1574.2
16....6	11	1655.9	75.7	1666.5	5	1637.0	74.8	1591.8
17....6	4	1637.3	32.3	1690.4	6	1606.0	32.3	1593.4
18....6	2	1633.0	69.0	1734.1	.....	.....	.....	.....

WEIGHT.

With reference to weight (See Table VI) it may be said that the deaf boys on the average are almost uniformly lighter than the hearing boys, and although there are exceptions to this at ages 7, 15 and 18, the numbers and the average deviations at these ages make the data non-significant. In the case of the girls there is greater irregularity in the data. This does not become evident, however, until after the age of 10 years. The girls are, still, at no age, where the numbers are at all significant as inferior to the norms for their hearing sisters as are the boys.

Again comparing the deaf children as a group with hearing children, it is found that in weight, there are only forty out of eighty-five boys, or 47 per cent, who are equal to, or above, the averages for hearing boys for the same ages, and with girls we find thirty-two out of a total of fifty-three girls of all ages, or 60.4 per cent, who are equal to or above the average of normal girls for their ages. While deaf boys are, on the whole, therefore, slightly lighter than hearing boys, deaf girls are considerably heavier on the average than are hearing girls of comparable ages.

HEAD MEASUREMENTS.*

In Table VII are recorded the head measurements of the deaf children, boys and girls by ages; the average maximum length and breadth of head of deaf children with the average deviation for each age group placed side by side with the corresponding figures for hearing boys and girls. (Note—See p 88.)

It will readily be seen that almost uniformly the deaf boys have shorter heads than the hearing, and that in breadth of head the deaf boys are almost as uniformly wider than the average of our norms from hearing children. Deaf girls show the same tendencies in head measurements as the deaf boys. The average maximum length of head of the deaf girls is less, while the average greatest breadth is greater, although indeed there are exceptions in breadth at ages 9, 11, 16 and 17.

*The Smedley cephalometer was employed to make these measurements. The details and methods with reference to the head measurements conform with those of our best American and German anthropologists.

TABLE V.

HEIGHT SITTING.

Age Yrs. Mos.	Boys				Girls			
	No. of cases	Deaf children, average height sitting. Millimeters	A. D.	Hearing children, average height sitting. Millimeters	No. of cases	Deaf children, average height sitting. Millimeters	A. D.	Hearing children, average height sitting. Millimeters
5....6	2	584.0	2.0	.....	2	593.0	5.0	.....
6....6	11	622.8	13.8	635.4	10	600.8	33.1	629.0
7....6	20	642.1	22.9	657.8	14	647.9	17.6	652.5
8....6	23	668.6	19.3	677.2	12	658.1	14.3	674.3
9....6	16	697.3	25.3	698.5	11	681.0	36.5	692.1
10....6	18	710.0	25.4	712.6	10	706.2	8.1	708.9
11....6	12	718.5	27.6	729.3	7	749.7	27.4	735.8
12....6	14	725.5	19.5	747.0	8	776.8	47.8	762.9
13....6	15	759.3	25.9	777.9	10	809.2	32.2	795.4
14....6	11	792.3	41.4	806.4	8	804.9	33.6	824.3
15....6	12	797.5	30.6	836.8	11	825.8	40.5	839.9
16....6	10	859.0	45.8	871.7	3	829.3	21.0	850.9
17....6	4	849.0	47.0	891.4	6	861.7	11.0	853.0
18....6	1	914.0	.....	914.6	2	865.0	23.0	857.2
19....6	.....	.....	.....	.....	4	855.8	31.8	.....

In addition to average lengths and breadths are given the averages of the products of length and breadth of the head of each child of both the deaf and the hearing children of the several ages (Table VII). By consulting the columns of the table which represent products it will be seen that in the case of the boys, the deaf are uniformly inferior to the hearing children, and this comparative status likewise obtains throughout with the girls with the exception of the age of 12, where the nine cases measured show a superiority on the side of the deaf.

In these measurements again let us consider the deaf as a group and compare them with normal hearing children of comparable ages. In length of head only sixty-seven cases out of a total of two hundred and seven, 32.3 per cent, are equal to or in excess of the average hearing child for each age group. In breadth, however, there are one hundred and twenty-four of the whole number of two hundred and seven boys whose heads are as broad or broader than the average—59.9 per cent.

Practically the same ratio obtains in the same measurements with the girls. Only thirty-seven out of a total number of one hundred and twenty-seven girls, or 29.1 per cent, are equal or greater in length of head than the averages of our normal group and in breadth there are eighty-seven out of the whole number of girls, one hundred and twenty-seven, or 68.5 per cent, whose heads are as wide or wider in greatest breadth than the average of the normals for their ages of hearing children.†

Deaf children have, as a whole, therefore, smaller heads than do hearing children, taking as a criterion the length, breadth product,* and they are more brachiocephlic, broad-headed.

†These norms of head measurements have been taken from the Statistics on Growth by Franz Boas, published in Report of Commissioner of Education, Chapter II, 1904. It is found in consulting the records of this Department that with reference to this particular physical measurement our cases are so largely atypical, that it is thought unsafe to adopt them in a comparative study of this character, and on this account recourse is had to the careful record of individual measurements in the report of Professor Boas. The standard deviations recorded in his tables are translated into the average deviation by using the formula A. D.=.7979δ.

*It would have been better, no doubt, to have rendered a comparison of head size based on the three head dimensions, employing as the height measurement the maximum height of the head above the floor of the auditory meati, but it was impossible for us to get satisfactory records of the last named measurement.

TABLE VI.

WEIGHT.

Age Yrs. Mos.	Boys					Girls				
	Deaf Children			Hearing Children		Deaf Children			Hearing Children	
	No. of cases	Average lbs.	A. D.	No. of cases	Average lbs.	No. of cases	Average lbs.	A. D.	No. of cases	Average lbs.
6.....6	5	46.4	2.6	227	45.6	5	42.2	2.6	204	43.8
7.....6	9	52.1	4.0	230	49.6	4	47.1	3.7	236	48.5
8.....6	17	54.8	4.2	255	55.4	4	51.3	4.0	232	52.8
9.....6	7	57.4	6.2	228	60.8	7	61.6	4.6	221	58.3
10.....6	12	62.0	6.2	254	64.65	5	63.8	4.2	240	64.0
11.....6	6	65.1	7.0	228	71.5	3	72.6	6.6	223	71.0
12.....6	6	66.9	7.7	256	78.4	3	85.6	6.4	247	80.3
13.....6	8	86.7	8.1	230	88.6	7	86.9	7.7	255	91.2
14.....6	5	88.2	12.5	250	98.5	3	96.9	17.2	301	103.4
15.....6	4	118.1	13.0	205	112.2	5	109.3	16.9	379	108.5
16.....6	2	116.8	11.8	146	121.5	1	99.7	.....	358	114.3
17.....6	2	122.1	6.6	92	130.3	4	129.1	8.1	251	116.2
18.....6	2	146.1	4.6	40	138.3	.....	.....	.....	.....	.....
19.....6	2	128.9	5.7	23	141.6	1	97.7	.....	48	120.0
20.....6	1	.....	.....	.....	158.2	1	107.4	.....	22	118.9
21.....6	.....	.....	.....	.....	.....	1	107.6	.....	4	120.5
24.....6	.....	.....	.....	.....	.....	1	116.6	.....	.....	.....

LUNG CAPACITY.

The measurement of the lung capacity was taken by means of the ordinary wet spirometer (Narragansett) and simply indicates the greatest amount of air that can be expelled from the lungs after a forced inspiration. This is after everything is considered, perhaps also the best test of the amount of air that is available for use. It may not give a direct index of the actual or possible size of the lungs, but it affords in a way a convenient, safe and valuable criterion of the degree of activity to which the vocal apparatus has been subjected, or is capable of exercising at the time the test is made, as well as the extent of the child's general physical activity. It is on this account quite natural that we should find that the deaf children are markedly inferior in lung capacity to normal hearing children, and this palpable inferiority, even in the case of those deaf children who were given special physical and speech training, gives us an indication of the immense amount of physical exercise other than speech that normal hearing children naturally indulge in and from which the deaf are barred by reason of their sensory handicaps. The intimate relation which exists between middle ear infirmities, high and narrow bone-palate formation with all the accompaniments and causes of obstructed breathing and diminished lung capacity has doubtless been observed by every careful investigator of normal children with merely defective hearing. It has likewise been pretty well recognized that the amount of usable air in the lungs of normal adults varies, within limits, with the degree of general physical activity. But besides suffering the consequences of inertness during early years, the deaf children do not give their lungs anything like the same degree of exercise that normal hearing children indulge in, since indeed they vocalize so little, and hence the cumulative effects of this double handicap becomes palpable and hard to overcome even with persistent exercise. In no other particular are the deaf children so uniformly or markedly inferior to the hearing normal children as in lung capacity. This is seen clearly by reference to Table VIII.

The deaf boys are inferior at every age. This inferiority, to be sure, is not so pronounced at ages 11 and 12 years, or at

TABLE VII.

HEAD MEASUREMENTS—BOYS.

Age	No. of cases	Length-Deafs		Length-Hearings*		Breadth-Deafs		Breadth-Hearings		Average product of length and breadth-Deaf	Average product of length and breadth-Hearing
		mm.	A. D.	mm.	A. D.	mm.	A. D.	mm.	A. D.		
6	9	180.4	7.1	178.2	5.3	143.2	4.4	140.7	4.1	25768	25866
7	28	172.5	7.1	179.6	5.1	142.1	4.8	142.1	3.7	24776	25627
8	26	176.9	8.8	180.1	4.5	144.3	3.9	143.6	3.8	25562	26325
9	15	175.5	7.1	181.2	5.0	144.4	4.1	144.0	3.7	25119	26649
10	22	181.7	6.2	181.7	4.4	146.8	9.1	144.5	3.6	26750	26912
11	17	180.5	6.2	183.4	4.8	146.0	4.4	144.6	4.0	26364	26707
12	18	177.5	7.8	183.3	4.8	147.1	5.3	145.6	4.5	26098	27242
13	18	181.5	7.2	185.2	5.1	146.7	4.0	146.8	3.8	26643	27186
14	13	182.7	5.5	187.2	5.1	151.0	4.1	146.9	3.8	27253	27371
15	17	181.9	7.0	188.3	4.9	148.5	5.3	148.1	3.7	27025	27832
16	11	184.6	5.2	190.8	6.1	147.6	5.6	149.2	3.8	27275	28515
17	6	185.3	4.6	191.6	4.8	148.0	6.3	149.5	3.9	27456	28777
18	4	185.2	6.7	.....	.....	147.7	4.2	.....	.....	27388	29088

HEAD MEASUREMENTS—GIRLS.

Age	No. of cases	Length-Deafs		Length-Hearings		Breadth-Deafs		Breadth-Hearings		Average product of length and breadth-Deaf	Average product of length and breadth-Hearing
		mm.	A. D.	mm.	A. D.	mm.	A. D.	mm.	A. D.		
6	11	165.8	6.0	173.1	3.7	140.1	3.1	138.0	2.8	23750	23984
7	12	169.1	4.1	174.7	4.8	142.5	4.6	139.1	3.3	23986	24571
8	15	172.7	4.4	175.0	4.7	141.6	2.7	140.3	3.4	24533	24639
9	11	170.0	3.8	176.3	5.0	135.9	3.7	140.2	3.8	23573	24782
10	13	174.1	6.7	177.8	4.7	144.9	3.4	142.1	3.6	25256	25429
11	11	173.6	5.1	178.2	4.3	141.4	4.8	142.1	3.9	24587	25542
12	9	180.5	6.2	180.0	4.3	147.0	2.6	143.2	3.7	26574	25564
13	12	179.0	5.9	181.7	5.4	146.1	5.5	144.0	3.9	26167	26386
14	7	182.0	5.1	182.5	5.1	144.5	4.7	144.0	4.2	26339	26431
15	13	179.6	6.1	184.3	4.1	146.0	3.8	145.4	3.6	26247	26370
16	6	175.8	4.1	183.7	4.5	143.0	5.6	144.6	3.9	25172	26206
17	7	179.0	6	184.8	4.4	143.4	4.0	145.2	3.4	25709	26791

*Among the hearing children the figures represent the average measurements of approximately 100 children of each sex for each age group.

[illegible]

the particular epoch in their lives at which we notice that some of the other measusements showed an equality or even superiority to the norms for hearing children. The same inferiority is apparent in the case of the deaf girls, and here again the greatest inferiority is shown at those years, 10, 11 and 12 years, at which we previously saw a lack of uniformity.

Here again it should be noted that because of the relatively small number of children examined at each age it is probably a safer criterion to take the total number of deaf children whose lung capacity is equal to or above the average for hearing children of the same age. In counting over the cases with this object in mind we find among the one hundred and forty-seven deaf boys, of all ages examined, that only eighteen, or 12.2 per cent, are equal to or above the average for hearing boys, and that in the case of the deaf girls thirty-two out of a total of ninety-five of all ages, or 33.9 per cent, are equal to or above the average for hearing girls, instead of 50 per cent, which figure would indicate them as normal.

It is interesting to note the position of deaf children with reference to lung capacity in the per centile group of hearing children.*

These are shown in Table IX, in which is indicated the per centile group of hearing children into which the average of the records of the deaf of each age fall. In a parallel column is given also the average for each age, of the ratios which the individual lung capacity records of deaf children make with the average lung capacity of hearing children of the same age. Thus it is seen that the average lung capacity of deaf boys, and girls as well, of the mean age of six and one-half years, falls in the

*For an explanation of these percentile groupings, see Report of the Child Study Department, Public Schools, Chicago, 1901, p. 13. In brief, the method of procedure was as follows: the four or five hundred records secured for the children at each age were distributed according to rank. The minimum measurement gives the zero percentile for the whole group. To determine the ten percentile, ten per cent of the number of cards is removed, beginning with the minimal record, and the highest measurement on the card so removed is recorded as the maximal limit of the ten percentile group. A similar placing and selecting of the next highest ten per cent of records with their minimal and maximal limits gives us the twenty percentile group, and so on, for the others.

TABLE VIII.

LUNG CAPACITY.

Age Yrs. Mos.	Boys					Girls				
	Deaf Children			Hearing Children		Deaf Children			Hearing Children	
	No. of cases	Average cu. cms.	A. D.	No. of cases	Average cu. cms.	No. of cases	Average cu. cms.	A. D.	No. of cases	Average cu. cms.
6.....6	9	833	181	227	1098	8	631	114	204	1008
7.....6	17	1003	174	230	1240	6	800	200	236	1121
8.....6	21	1164	172	255	1388	9	983	148	232	1215
9.....6	11	1282	169	228	1549	10	1283	168	221	1360
10.....6	19	1466	146	254	1659	8	1394	84	240	1456
11.....6	12	1604	195	228	1799	7	1571	153	223	1587
12.....6	12	1704	138	256	1956	9	1706	349	247	1729
13.....6	17	1868	186	230	2246	11	1828	285	255	1924
14.....6	7	2171	367	250	2527	5	1990	352	301	2117
15.....6	9	2239	290	205	2858	9	2106	341	379	2225
16.....6	6	2817	277	146	3363	5	2150	380	354	2306
17.....6	2	2250	755	92	3570	6	2192	325	251	2304
18.....6	3	3067	843	40	3700	3	2133	310	137	2351
19.....6	2	3200	150	23	3872	.....	.....	.....	48	2441
20.....6	.....	.....	.....	.....	.....	1	2300	.....	22	2348
21.....6	.....	.....	.....	.....	.....	1	2150	.....	4	2250

TABLE IX.
LUNG CAPACITY.

Age. Yrs. Mos.	Boys: Percentile Group of Normals in which deaf children fall	Boys: Average of the ratios of deaf children to normal hearing	Girls: Percantile Group of Normals in which deaf children fall	Girls: Average of the ratios of deaf children to normal hearing
5....6	.....	.....	0-10	.74
6....6	0-10	.81	0-10	.62
7....6	10-20	.82	0-10	.77
8....6	10-20	.83	20-30	.83
9....6	30-00	.90	10-20	.82
10....6	20-30	.88	40-50	.96
11....6	20-30	.91	60-70	1.03
12....6	10-20	.85	10-20	.85
13....6	10-20	.81	20-30	.88
14....6	10-20	.77	10-20	.84
15....6	10-20	.75	40	.96
16....6	10-20	.79	40-50	.98
17....6	0-10	.63	40-50	.98
18....6	Below limits of normals	.48	.....	.....
19....6	.....	.....	30-40	.95

ten per centile group of hearing boys and girls of that age, and on the average, deaf boys have a lung capacity .81 as large as hearing boys, and deaf girls .74 as large as hearing girls, at this age.

The table presents the data so clearly that further comment is unnecessary. The striking inferiority of deaf children of both sexes at all ages, almost uniformly, stands out in this table even more convincingly than in Table VIII.

STRENGTH OF GRIP.

To determine to what degree the strength of the grip of deaf children is inferior or superior to normal children of the same age and school conditions, an adjustable grip dynamometer was used, which registers the strength of grip in kilos (1 kilo= 2.2 lbs.). The gross results of these tests are given in Table X. The ages, number of pupils of each age tested, grip of right and left hand are given in parallel columns for boys and girls respectively, and the norms of the grip of normal children (taken from Child Study Report No. 2, 1899-1900), placed in columns adjoining for ready comparison.

By consulting Table X we find that the deaf boys are slightly superior in right hand at ages 7, 8, 9 and 11. After the age of 12 years they are uniformly inferior, and this inferiority increases with age. The strength of left hand is superior with

TABLE X.

STRENGTH OF GRIP.—DEAF BOYS.

Age Yrs. Mos.	No. of cases	Right Hand: Deaf children, average grip, kgs.	Right Hand: A. D.	Right Hand: Hearing children, average grip, kgs.	Left Hand: Deaf children, average grip, kgs.	Left Hand: A. D.	Left Hand: Hearing children, Average, grip, kgs.
5....6	2	6.5	.5	.....	5.5	.5	7.12
6....6	7	9.7	1.9	9.97	8.7	1.7	9.29
7....6	28	12.7	2.7	11.51	11.7	2.0	10.92
8....6	24	15.8	2.5	13.31	14.6	2.8	12.43
9....6	20	16.4	2.4	15.37	15.6	3.0	14.51
10....6	23	19.5	2.8	17.67	17.8	2.1	16.66
11....6	17	21.7	3.5	20.03	19.5	2.4	18.80
12....6	18	21.7	2.8	22.45	20.7	3.0	20.62
13....6	18	23.4	3.0	26.43	21.1	2.2	24.40
14....6	14	28.9	8.1	30.40	28.5	6.5	28.40
15....6	14	28.1	4.9	36.38	26.3	6.3	33.73
16....6	11	38.6	7.2	42.35	37.2	6.7	39.40
17....6	6	37.7	2.3	47.14	37.4	1.6	42.87
18....6	4	35.5	7.0	51.43	37.5	10.0	47.16
19....6	.....	.....	.....	.....	.....	.....	.....
20....6	.....	.....	.....	.....	.....	.....	.....

STRENGTH OF GRIP.—DEAF GIRLS.

Age Yrs. Mos.	No. of cases	Right Hand: Deaf children, average grip, kgs.	Right Hand: A. D.	Right Hand: Hearing children, average grip, kgs.	Left Hand: Deaf children, average grip, kgs.	Left Hand: A. D.	Left Hand: Hearing children, average grip, kgs.
6.....6	10	8.8	2.2	9.12	8.10	2.10	8.49
7.....6	7	12.9	1.9	10.65	9.80	2.50	9.99
8.....6	14	11.1	2.3	11.67	10.60	2.00	10.96
9.....6	11	12.6	1.6	13.88	12.20	1.10	12.99
10.....6	13	15.4	1.7	15.43	14.70	2.30	14.46
11.....6	11	16.8	3.3	17.65	15.60	3.10	16.58
12.....6	9	19.3	2.3	20.19	16.70	2.70	18.97
13.....6	12	24.2	4.2	23.49	22.90	4.58	21.80
14.....6	10	23.7	3.5	26.10	22.40	3.12	24.03
15.....6	14	27.5	3.8	27.91	25.40	4.07	25.80
16.....6	5	35.2	3.4	29.50	30.10	2.80	27.31
17.....6	7	32.0	3.1	29.63	29.00	2.85	27.55
18.....6	1	33.0	.....	29.87	28.00	.....	27.77
19.....6	4	39.0	2.0	.....	32.25	5.25	.....
20.....6	.....	.....	.....	.....	.....	.....	.....

the deaf boys at ages 7, 10, 11, 12 and 14 years and inferior at ages 6, 8, 9, 12, 13, 15, 16, 17 and 18.

The deaf girls are weaker in right hand grip than the norms for hearing girls at ages 6, 8, 9, 10, 11, 12, 14, 15 and slightly stronger at ages 7, 13, 16, 17 and 18. Practically the same comparative status obtains in grip of left hand of these deaf girls.

Again because the number of cases of the deaf is so small, a comparative estimate of the children as a whole may better be

made from the number of children of the group who are equal to or superior to the average of our normal children in this test of strength. In actual numbers it is found that ninety boys out of two hundred and four, or 44.1 per cent, are equal to or superior to the averages for hearing children. With the left hand, as a group, the deaf boys stand higher than with the right hand, inasmuch as one hundred out of two hundred and four, or 49.7 per cent, are equal or superior to the average of children of the ages included in the norms.

In the case of the deaf girls there are fifty-five both left and right hand out of the total number of one hundred and twenty-four, or 44.4 per cent, who stand equal to or superior to the norms of hearing children for the ages represented. It appears, therefore, that the deaf boys as a group more nearly approach the norms of their hearing companions than the girls with the left hand, while the advantage is slightly in the favor of deaf girls as a group in respect to the right hand.

GRIP INDEX.

The observation has quite frequently been noted * that left-handedness is found more frequently among deaf children than among the hearing. Various reasons have been assigned for this peculiarity, although all agree, however, in supposing that there is some intimate connection between speech and this differentiation in hand power or selectiveness in manipulation.

In Report No. 2 (1900) of this Department, the data with reference to changes in growth of hand strength of normal children were presented. Moreover, it will be remembered that in Prof. J. Mark Baldwin's studies of his two children ** there was an account of a noticeable preference for one hand over another in grasping for attractive objects which made its initial appearance about the time of speech beginnings. This apparent correlation of the two modes of expression at the time of their origin seems to be again in evidence at the time of the great

**Mental Development in the Child and the Race, 1896, chap. I.

*Hartmann, Ueber Taubstumme, Deutsch med. Wochenschr, III, 1877.

Deaf-Mutism—(trans. Cassell), 1880. J. Kerr Love; Deaf-Mutism, Chap. I, Glasgow, 1896. St. Hilaire; La Surdi-Mutite, p. 251, Paris, 1900.

transformations of life. An instance of this occurs during the pubertal epoch. In the reports of this department attention was called to the fact that the greatest difference between the strength of the hands occurred at early adolescence contemporaneously with the greatest changes of voice. Another group of facts somewhat akin in import relates to speech defects. It was found in our work that by far the greatest number of minor speech defects was discovered among children who were pronouncedly left-handed or who acquired ambidexterity by reason of the teacher's persistence and the parents' training. This whole line of reasoning may be merely a matter of coincidence. It seems much more reasonable to suggest that all cases of minor speech defects correlate directly with inferior intelligence, as

TABLE XI.

MANUAL INDEX.*

GRIP.

Age Yrs. Mos.	Boys				Girls			
	Deaf		Hearing		Deaf		Hearing	
	No. of cases	Index per cent	No. of cases	Index per cent	No. of cases	Index per cent	No. of cases	Index per cent
6....6	7	88.8	.....	.....	10	89.6	.....	.....
7....6	28	90.0	8	93.1	7	85.0	9	90.0
8....6	24	87.0	29	92.0	14	93.0	28	92.9
9....6	19	86.0	44	93.1	12	91.0	39	91.5
10....6	23	89.0	42	93.04	13	92.0	41	91.7
11....6	16	94.0	44	95.4	11	94.0	45	92.1
12....6	18	92.0	40	91.6	9	86.0	47	92.4
13....6	18	91.0	48	91.1	12	95.0	45	93.6
14....6	14	94.0	36	91.8	8	92.6	64	93.1
15....6	14	93.0	31	92.5	14	91.0	47	91.7
16....6	11	93.0	20	90.9	6	93.16	39	90.6
17....6	5	94.2	90	91.8	7	90.85	51	89.9
18....6	4	93.2	37	89.4	4	83.0	75	89.9
.....	.....	.....	.....	.....	.....	.....	.....	.....

*NOTE.—The measure of the Index is in each case, the per cent which the weaker hand is of the stronger. The degree of right- or left-handedness is not therefore indicated.

indeed our work with subnormal pupils would seem to indicate, and that ambidexterity is one of the marks of inferior mentality instead of the converse, as further work with reform school boys gave evidence of. (See General Reports II and III). This feature of the whole matter is held in reserve for another series of studies.

It must not be forgotten, however, that this matter of the

number of deaf children who are left-handed is a relatively secondary problem in comparison with the larger aspects of growth in hand strength which center about the differences in hand power between the right and left hands of deaf children throughout the years of growth.

This growth in specialization is indicated in Table XI, in terms of manual index. The measure of the manual index is in each instance the per cent which the weaker hand is of the stronger, and for convenient comparison the index of normal hearing children is placed in adjoining columns, both for boys and girls.

There seems to be greater difference—that is, the manual index is less—between the strength of grip of the hands of deaf boys as compared with hearing boys at the ages 7, 8, 9, 10 and 11 years. Beginning with the age of 12 years and from 12 to 18 years, both inclusive, there is less difference in the strength of the hands of deaf boys as compared with their hearing mates of corresponding ages. In comparing the younger deaf boys with those older in years it is found that, in general, the difference between the strength of the hands tends to diminish, that is, whereas, in the early years the manual index is less than ninety, it goes up to ninety-three or ninety-four in the older years. As the deaf boys increase in age there is less and less difference between the strength of their hands, less specialization or selectiveness in manual power. This is the direct opposite of what we find among hearing boys, among whom we find that the strength of hands is more equal in the early years, and that the difference between the hands increases perceptibly as they grow older.* This may be only another indication that deaf boys are later in maturing than hearing boys, or that the lack of activity of all sorts and especially of constructive manipulation of materials is so great an environmental handicap as to practically make the deaf boys a species by themselves. There is by no means so great uniformity found in the differences of hand power of deaf girls as compared with their hearing companions of equal ages. There is less difference between the strength of

*Compare Binet. Quotation from Dr. St. Hilaire, "that grip of left hand differs less from right hand than normals." Also, Kilian.

the hand of deaf girls at ages 8, 10, 11, 13, 16 and 17 years; and greater difference between the hands of deaf girls than in the case of hearing girls at ages 7, 9, 12, 14, 15 and 18 years respectively. The general tendency, however, so far as this can be read from the data at hand, seems to show that up to the age of 12 years there is *less* difference between the strength of hands of deaf girls than hearing girls of equal ages—the direct opposite of the relation that was found to obtain in the case of deaf boys.

In comparing the younger deaf girls with those of older years we find that the differences between the hands increase as they grow older, the opposite of what we found prevailing among deaf boys, and more in line with the trend of development of normal hearing girls. Again this may be largely due to the fact that the difference in activity which is found between deaf and hearing girls is not so great as the difference between deaf and hearing boys.

To summarize, the nature of the data is such as to make it unwarrantable to assert that any differences exist in relative strength of the two hands of deaf girls as compared with their hearing sisters, but with reference to deaf boys the data seem to indicate that for younger years, during pre-adolescence, more differentiation in the strength of the two hands, respectively, obtains than among the hearing, and for the adolescent years, less differentiation prevails than among children with normal hearing—that is, the deaf are more ambidexterous.

MOTOR ABILITY.

In examining the voluntary output of energy one should take into account not only the gross and spasmodic total result of effort usually called strength and represented in one instance as hand-grip (Table X), but also the factor of the quickness or speed of voluntary movement. This factor of voluntary motor ability is recorded herein as simple tapping-time, and in our tests registers the number of taps that can be made with an electric tapper during thirty seconds. The two most important elements in a test, namely, precision of movement and constancy in effort and execution unfortunately we shall have to ignore entirely, and hence there is presented only the total number of taps made during thirty seconds.

TABLE XII.

MOTOR ABILITY—DEAF BOYS.

Age Yrs. Mos.	Right Hand: No. of cases	Right Hand: Deaf children, average no. of taps, 30 secs.	Right Hand: A. D.	Right Hand: Hearing children, average no. of taps, 30 secs.	Left Hand: Deaf children, average no. of taps, 30 secs.	Left Hand: A. D.	Left Hand: Hearing children, average no. of taps, 30 secs.
5....6	2	76.1	15.0	.....	72.0	12.0	.....
6....6	7	117.8	19.5	.....	100.5	2.6	.....
7....6	20	120.1	13.5	.....	97.7	13.8	.....
8....6	22	129.2	18.6	147	105.8	22.6	117
9....6	22	137.9	10.8	151	115.0	12.3	127
10....6	22	138.0	19.5	161	114.6	19.0	132
11....6	17	146.8	16.1	169	124.1	16.1	141
12....6	18	163.3	15.5	170	141.2	14.4	145
13....6	17	165.3	16.9	184	145.0	20.0	156
14....6	14	174.0	21.5	184	145.4	18.7	155
15....6	17	176.4	26.4	191	152.8	16.6	169
16....6	12	182.0	21.5	196	159.5	20.1	170
17....6	7	162.4	9.9	196	146.3	18.6	174
18....6	4	164.5	12.5	197	150.6	25.7	183
19....6	.....	.....	.....	.....	.....	.....	.....
20....6	.....	.....	.....	.....	.....	.....	.....

MOTOR ABILITY—DEAF GIRLS.

Age Yrs. Mos.	Right hand: No. of cases	Right hand: Deaf childen, average no. of taps, 30 secs.	Right hand: A. D.	Right hand: Hearing children, average no. of taps 30 secs.	Left hand: Deaf children, average no. of taps, 30 secs.	Left hand: A. D.	Left hand: Hearing children, average no. of taps, 30 secs.
5....6	1	115.0	.....	.....	105.0	.....	.....
6....6	8	112.9	11.1	.....	95.1	26.0	.....
7....6	13	109.9	14.5	.....	103.7	21.3	.....
8....6	14	122.5	12.2	146	93.8	17.0	117
9....6	10	134.9	14.5	149	116.5	13.8	118
10....6	13	141.5	17.2	157	128.2	12.1	129
11....6	10	148.2	22.4	169	132.2	13.0	139
12....6	9	153.7	20.6	169	131.4	20.2	140
13....6	12	156.9	18.1	178	137.1	26.9	153
14....6	7	157.7	21.1	181	133.3	14.0	157
15....6	12	174.0	24.1	181	158.7	21.0	159
16....6	6	177.1	12.8	188	161.1	10.5	167
17....6	7	175.7	14.9	184	163.4	11.9	162
18....6	1	178.0	.....	193	159.0	.....	169
19....6	3	188.0	18.0	.....	171.0	9.3	.....
20....6	.....	.....	.....	.....	.....	.....	.....

In Table XII are given in parallel columns the following:

(a) The number of children tested at each age.

(b) The average number of taps made in thirty seconds by the children.

(c) The average deviation of the records from the average. For ready comparison the averages for normal children for corresponding ages are placed beside those of the deaf. The records are given for both boys and girls for the right and left hands.

By going over this table somewhat in detail one sees that the deaf boys are with the right hand notably and uniformly slower than normal hearing boys, and that although not so quick at any age with the left hand, they are not in this case so inferior, and at the age of twelve years almost equal to the hearing boys. Moreover, this relative slowness seems to increase as they grow older.

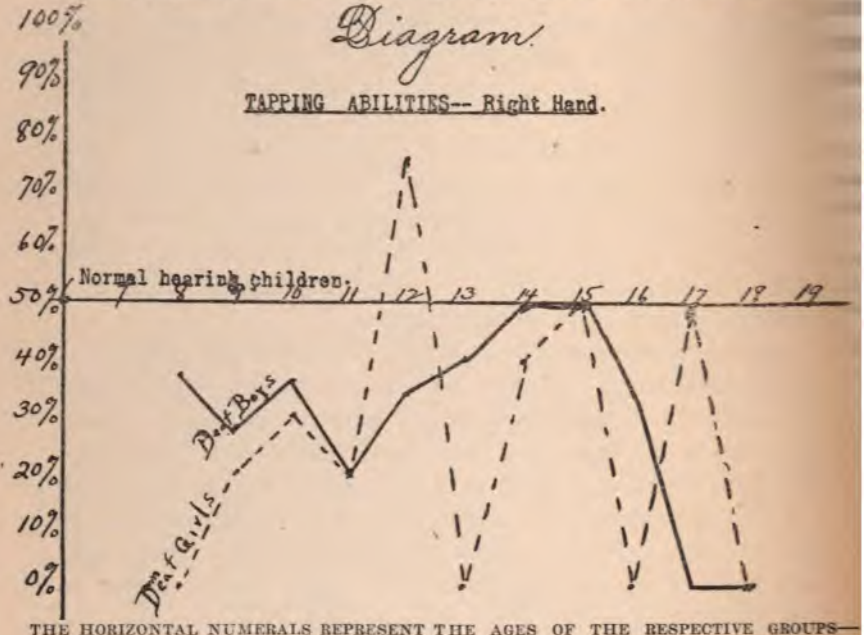
In the case of the girls we find that they too are much slower at all ages with the right hand, and with the left, though slower than hearing girls, they are at no age as much slower relatively as with the right hand. Indeed, at the ages fifteen to seventeen, they are almost equal in quickness to hearing girls with the left hand, and at the age of seventeen years they are actually quicker on the average. Moreover, the inferiority of the girls, unlike that of the boys, appears to decrease with age, and this may be only another indication of the increased degree of general physical activity in which they come to indulge, as well as of other environmental factors.

Again on account of the paucity of numbers at each age it is advantageous to take the deaf boys and girls as a group and compare them in quickness directly with the hearing boys and girls for the corresponding ages represented in each deaf group. It is thus found that of all deaf boys examined, only forty-one out of one hundred and seventy-two, or 23.8 per cent, are as fast or faster than the averages for hearing boys of their ages with right or left hand, and that only twenty-nine of a total of one hundred and one, 23.8 per cent, deaf girls are, with the right hand, equal to or above the average for normal hearing girls of corresponding ages, while only thirty-four out of ninety-nine cases, 37.3 per cent, recorded for quickness of left hand, equal or surpass the averages of hearing girls for the same ages.

The relative standing of the deaf, all in all, when compared with hearing children in the cases of both boys and girls, is therefore found to be, even less favorable, when rapidity of movement is involved, than was found in the measurements of stature and weight, and only slightly better than the relative standing of the deaf in lung capacity.

The facts are diagramatically exemplified in the accompany-

ing figure, which indicates the positions occupied on a per centile scale drawn from a large number of hearing children of each age, the average standing of deaf boys and girls of corresponding ages. From this it is seen for example, that the average standing of seven year old deaf girls is lower than the average of the lowest 10 per cent of the records selected from the performances of hearing girls. In one instance, only, 12 year old deaf girls, does their average tapping rate exceed the aver-



THE HORIZONTAL NUMERALS REPRESENT THE AGES OF THE RESPECTIVE GROUPS—THE PERCENTS ON THE VERTICAL LINE SHOW THE RATINGS OF THE DEAF BOYS AND GIRLS FOR THE DIFFERENT YEARS.

age of hearing girls, and in the averages for three age groups only among boys do their performances equal the average of hearing children.

Further, in the tests of motor ability as with the hand-strength there is an advantage and interest in giving the manual index. This index of manual quickness (See Table XIII) measures in each instance the fraction which the slower hand

is of the faster. In comparing then the manual index, as determined by relative quickness of movement, of deaf boys with hearing boys, it is seen that there is practically no difference observable until after the age of eleven and one-half years. After this age, however, the manual index is higher among the deaf boys, showing that the difference in motor control of the right and left hand is not so great as among hearing boys of the same ages, or that specialization in this method of expression has not attained as high a degree among the deaf as the hearing, that is, the deaf tend more to ambidexterity than do ordinary hearing children.

TABLE XIII.

MANUAL INDEX.*—MOTOR ABILITY.

Age Yrs. Mos.	Boys				Girls			
	Deaf		Hearing		Deaf		Hearing	
	No. of cases	Index	No. of cases	Index	No. of cases	Index	No. of cases	Index
6....6	6	79.3	.....	.....	8	85.5	.....	.....
7....6	25	79.9	8	79.0	12	83.9	11	80.1
8....6	22	81.18	33	81.4	14	79.0	8	80.32
9....6	21	83.7	60	82.6	10	83.6	44	79.4
10....6	22	81.9	47	82.3	12	86.0	48	82.4
11....6	17	82.5	49	83.0	10	88.2	46	83.1
12....6	18	87.1	44	82.5	9	86.1	49	80.7
13....6	17	85.5	50	84.6	11	85.5	44	86.7
14....6	14	83.2	40	82.08	7	85.1	68	86.1
15....6	16	86.1	35	86.6	11	87.2	48	86.7
16....6	11	91.7	21	87.1	6	91.1	40	88.0
17....6	7	88.9	13	88.7	7	92.1	51	88.1
18....6	3	86.2	3	93.3	1	89.0	24	90.9

*NOTE.—The measure of the Index is in each instance the per cent which the slower hand is of the faster.

Again in running our eye over the data in each column to determine differences due to age among deaf boys, it will readily be seen that in general there is not so great a difference between the younger and the older deaf boys as is found to obtain in the case of the younger normal hearing boys and the older hearing boys.

With respect to the manual index of deaf girls it is seen that at nearly every age there is not so great a difference in the control of the hands as is found to prevail among the hearing girls of comparable ages. This difference between the deaf and hearing girls is very pronounced at some ages, notably at

ages, seven, nine, ten, eleven, twelve, fifteen, sixteen, and seventeen years and not so marked or even slightly less at ages, eight, thirteen, fourteen, and eighteen years. It appears safe to warrant the statement, however, that there is less pronounced differentiation or selectiveness in motor manipulation among deaf girls than is found in the case of their hearing sisters.

One fact stands out prominently in the tests of motor ability, notably that both deaf boys and deaf girls of 12 years and older more nearly approach the standing of hearing children than do those of the younger years. That is, as deaf children increase in age, they become more nearly like normal hearing children. There seems to be no other casual factor to which this relative increase in efficiency with age can be attributed except that lack of definite motor control is intimately related to mental maturity. Since in their early years, deaf children have had few experiences as compared with hearing children, this increase in motor ability would be more rapid with mental training than is that of the hearing child. This suggestion of the very close correlation between mentality and the development of the nervous mechanism is likewise illustrated and exemplified by work which has been done on primitive people. These show that while not greatly inferior to the normal average white people of civilization in strength for their stature, there is a marked inferiority in their quickness of response. This difference in moving time is apparent even in the doing of things with little or no meaning, as well as in the performance of acts that require a more complex mental factor to initiate and control them. It may be said that responses are the result of stimulation, and that the nervous mechanism, subject to the more varied and greater number of sensations appreciated, other things being equal, will respond the more rapidly. This correlation suggests the very interesting psychological problem of the inverse influence of the psychical on the efficiency of the motor mechanism. The question of the influence of bodily movements in giving rise to mental content has long been recognized. The influence of the psychical on the physical means that an unused mind, no matter from what caused, is accompanied by sluggish bodily action. It suggests also, the influence which school training of the purely mental type has in affecting an increase in manual productivity.

MENTALITY.

The problem of determining the mental status of deaf children is infinitely more complicated than that of estimating the psychical efficiency of hearing children. This is to be attributed in no small measure to the fact that their symbols for expressing themselves and making known to us the contents of their minds are few and inadequate.

On account of the paucity of symbols, too, it becomes exceedingly difficult to devise any tests which may be used with the same degree of facility and certitude on the deaf and hearing children alike, and thus make a quantitative statement of the differences of mentality between a deaf and hearing child. This does not mean, of course, that the mental condition of a deaf child cannot be determined with a fair degree of certainty by one who has had special training and has acquired special skill in bringing out and interpreting responses which are indicative of the deaf child's mental power. In testing the mentality the aim was more specifically that of examining definite functions rather than of evaluating proficiency in any particular line of school training.

Proceeding from the simplest to the more complex processes, simple tests were given to determine the following functions of the child:

(a) Imitative ability;

(b) Suggestibility; i. e., his ability to follow directions;

(c) Perceptive ability; i. e., the child's efficiency or skill in discriminating sense differences in degree and kind.

(d) Capability in reproducing immediately (at once) a context which is relatively without connection with other meanings, i. e., the immediate sense memory. (With the deaf children the reproduction of things heard is eliminated.)

(e) Ability to think, i. e., to intelligently use such concepts as cause and effect, part and whole, and the like.

With reference to the general power of thinking, it should be stated that in speaking of such a highly complex mental activ-

ity as the power of forming good judgments, it is always necessary to tell in advance the particular field in which this activity is operative. It is a common observation that persons may exercise good judgment in dealing with one phase of human life, and yet show exceptionally poor judgment with another group of facts. A man, for instance, may be sound in science but most eccentric and unsafe in business and religion. Hence it is unwise to use any arbitrary tests for general comparison of individuals or groups, who may happen to have had diverse interests and different training. In this test of the deaf children, an estimate was made merely of each child's ability to size up situations and in general to interpret and communicate meanings.

In addition it should be noted that the simpler tests were used for diagnostic purposes, and no effort was made to state them in quantitative terms. The question of primary importance was: Has the child a mind which is well balanced or sane, and susceptible of training, or is he feeble-minded?

Imitation.

To determine whether the child had sufficient mental ability to imitate, the following tests were employed: The child was placed at a distance of four or five feet facing the experimenter. He was encouraged to observe attentively and execute the same acts which the experimenter performed, such as (1) placing the feet together, heels and toes; (2) standing erect, with head and shoulders thrown back; (3) raising one or both hands to a horizontal position at the side, and in front or perpendicularly above the shoulders; (4) with the hands extended horizontally in front, the child spread apart his fingers, following the experimenter, holding now one, and now two, together.

Suggestibility.

To determine the child's suggestibility, two tests were employed. In the first the child performed certain acts which he had just seen the experimenter execute. He made three, four or five, or any number of steps, after watching the experimenter perform the same, or he tapped a certain number of times in response to the same number performed by the experimenter. This implies that an idea or image of the performance or end to

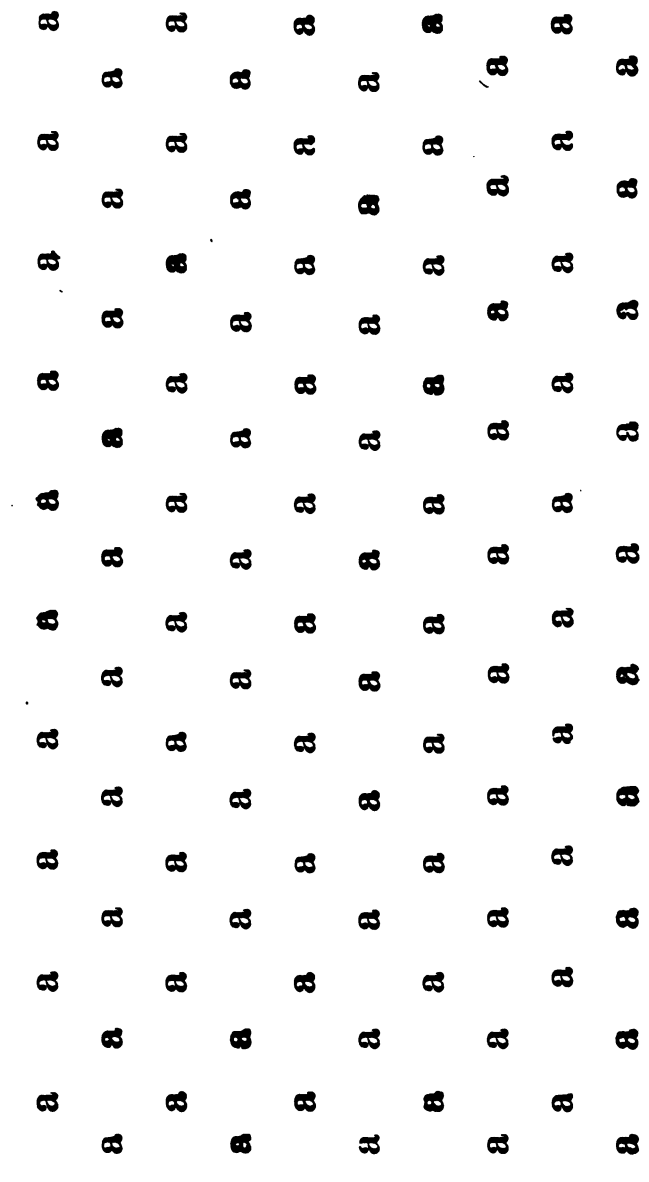
be attained exists in the mind of the child, and that he has the ability to work out the meaning of the image or idea in some definite act or series of acts. There is also involved in a suggestion test the concept or translation from one sense to another. In order for the child to take three steps as a result of having seen three hand movements, it is necessary that he have definitely formed the concept of three, and this is by no means a simple function.

In the second test for suggestibility packs of specially prepared cards were used, and the child was required to sort them in groups of their likes and unlikes. Three of such packs were employed, each containing forty cards. On the cards of the first series were pasted small circles of eight elementary colors. After the cards had been thoroughly mixed the child was requested to sort them into piles, according to color. On the cards in the second series were pictures of familiar objects instead of colors; in the third simple geometrical forms. The procedure in all three parts of the series was practically identical. However simple and elementary these tests for imitation and suggestibility may seem, experience with large numbers of children in the Child Study laboratory has shown that feeble-minded children are unable to execute even such simple operations.

Perception.

As tests which largely involve simple perception three were employed; one calling for sense discrimination by sight, the second by the sense of touch and the third bringing into play the muscular sense.

To test the first function—sense discrimination by sight—use was made of a special form of what is customarily known as the *"A" Test.* (See form of this test, pp. 50 and 51.) The test is one which has done service in the Child Study Laboratory of the Chicago Public Schools for a number of years, and was invented and devised largely for diagnostic purposes. As is seen, the test is composed of two parts. In the first, one hundred "a's" (18 point size) are arranged symmetrically in rows, so as to involve the perceptive factor to a negligible degree, in marking them out, while in the second half of the test the one hundred "a's" are scattered promiscuously among the remaining let-



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DEPARTMENT OF CHILD STUDY AND PEDAGOGIC INVESTIGATION

Lskse evavy dawma kzaje xatzs cnjaf aruja ahalv iwige fkakp xmvwa parka sugho rvsth yraea zaqwb qiajc mvgpa ehaih angao ymljd tnazd Wdaks gsbnc azeqa grhng nayvk zlaah spqva iaucf akiwr hkdaf tafta puwqa rayxe yoirr vbuyx laehu qnhra kaqul. Vaiso rnhay tbcma bjezw uvaru oajba jmzao tutzb zkapd lhnaf batxz xslac dhxrd feqag ogaxl gunka onawz fatdg. Plcxw mcfra ifano pivka xawye cjrga laxoe adqfb linam asduh himfa csamy jckax ejwoa mpadu typia easvy nzyaz diuno ebola watma majtj abcta jqafb ahuys. Oqaql iumwa kaqpv baxap sxaob cmfaz qatay aqizs igabg narbq wogad alcbg bpagx vyxpa mafwe vtjat kpjea

ters of the alphabet, so as to form one hundred groups of letters of five each.

The first part of the "A" test was designed with two objects in view. By taking the time required by the child to place a stroke with a pencil through each of the one hundred "a's" when he has been requested to do it as rapidly as possible, a measure is afforded of a certain type of *motor ability*. But in addition to this there is also afforded, which is more particularly to the purpose of the test in hand, a measure of the physiological, or motor *time* consumed in marking one hundred "a's." After completing part one, the child was instructed to place a stroke through the *a's* in the page print (see p. 51), as quickly as possible, being sure to mark out every *"a"*; the instructions being uniformily as given above for deaf and hearing children alike. A measure of the time required to perform this test was also taken and a record made of the number of *"a's"* not marked.

It is readily apparent that at least two factors enter into the selection and marking of *"a's"* as called for in this test; the one a mental factor concerned in the several acts of discrimination in finding the "a's," and the second, physiological, having to do with the motor task of making the marks. To disintegrate these factors and arrive at a measure of the purely mental time actually involved in perception, is the point of chief moment, to make the test of value in stating quantitative differences between individuals and groups. And this is acomplished approximately by subtracting the *motor time* gotten in the first part of the test from the total time required to perform the second part. This latter we shall call the *"Perception Time"* (P. T.) in the discussions and tables.

There is one factor in connection with the *"A-Test"* which makes the results awkward to handle. If every child marked out all the *"a's,"* differences in perception might be stated directly in terms of the *perception time*. The fact is, however, that many children fail to find all the *a's*, there being sometimes as many as forty that the child does not see and mark out. Here, consequently, are two variables, which thus far there has been found no satisfactory way of equating in terms of each other. Thus

TABLE XIV.

PERCEPTION TEST.—"A" TEST.

Age Yrs. Mos.	Deaf children: No. of cases	Motor time, average	*A. D.	Perception time, average	A. D.	Average No. of letters not marked	Hearing children: No. of cases	Motor time, average	A. D.	Perception time, average	A. D.	Average No. of letters not marked
7....6	9	130.9	19.4	179.0	76.0	10.5	5	88.0	19.6	92.6	28.8	9.0
8....6	16	113.1	30.4	102.5	25.0	6.6	23	86.2	15.3	78.5	21.4	7.5
9....6	15	97.6	20.6	126.5	41.6	8.1	37	82.1	9.7	78.5	19.8	6.1
10....6	26	86.4	20.2	102.2	29.1	10.1	33	63.6	6 4	59.2	16.2	7.0
11....6	15	103.7	24.8	85.2	38.3	7.4	38	60.5	11.0	49.7	12.5	4.3
12....6	9	78.1	16.6	97.4	22.7	7.9	39	44.7	8.1	49.6	10.4	3.3
13....6	17	53.6	8.2	65.0	19.4	4.5	33	48.9	8.8	45.4	10.8	3.0
14....6	9	56.9	11.4	60.9	11.4	3.8	28	48.3	6.4	38.6	10.2	1.41
15....6	20	60.1	7.9	55.7	13.3	3.4	14	46.1	5.6	43.1	10.7	0.57
16....6	12	53.3	8.8	56.6	19.8	2.4	3	40.0	0.0	40.0	0.0	0.3
17....6	5	51.0	10.5	63.8	16.3	5.4	.....	.....	.....	.....	.....	.....
18....6	5	46.6	8.8	60.5	9.5	5.5	.....	.....	.....	.....	.....	.....
19....6	3	49.7	7.7	45.3	7.7	4.7	.....	.....	.....	.....	.....	.....

*A. D.—Average deviation.

it is impossible to say, exactly, whether a child who has marked out all the *a's* and whose perception time is 60 seconds, has better or poorer ability, as regards this test, than the child whose perception time is, say one-half as great—30 seconds—but who has failed to mark out ten or fifteen of the *a's*. A probable determination of the efficiency of children in the test, however, was secured by calculating from the time required to mark out the *a's* in each case, the estimated time that would be required to mark out 100 *a's*. That is, in the event that it took 170 seconds to pick out 85 per cent of the *a's*, it was estimated that 200 seconds would be required to pick out all the *a's*. No correction, however, was made for *a's* overlooked in those cases where at least 96 per cent had been marked. For the most part the children were tested one at a time, and in no case were there more than three children given the test together.

All the data from the *"A-Test"* available for statistical presentation will be found in the accompanying tables. (See Tables XIV and XV.) The tables are sufficiently self-explanatory to require little direction in reading off the data and their significance. To facilitate comparisons with hearing children the data from this group are placed in parallel columns with those from the deaf. It is seen that there are indicated for each age: (1) the number of children examined, (2) the average motor time, and (3) the average perception-time (total time less motor time), together with the average deviation of the individual records from the mean or average of each group; also the number of *a's* on the average not discerned.

Table XIV exhibits the data so as to show the relative number and per cent of deaf children of each age whose records fall below the average or mean performance of hearing children of corresponding ages. It is, indeed, the more telling of the two tables, too, inasmuch as the influence of the small number of records which make up the average of each group, and the skewing tendencies of extreme records, loose their undue weight.

Motor Time—

We are not concerned particularly, with the question of motor proficiency in the present instance, but it is worth while in passing to note the comparative standing of deaf and hear-

ing children, respectively, in *motor time* as measured by the first part of this test—a form of motor-ability test. The relative motor inferiority of deaf children stands out most clearly during the earlier years, but it is by no means lacking for any of the ages considered in these comparative measurements, since at no age is the average motor time for deaf children as low as for their normal hearing companions. Table XV shows the relative motor inefficiency of deaf children, if anything, even more conclusively. We find that at the age of seven the records of all deaf children are poorer than the average for hearing children. At eight years of age, 11 of 16, or 69 per cent of the deaf make poorer records; at nine years, 9 of 15, or 60 per cent; at ten years 20 of 26, or 77 per cent, and when children of eleven years are compared, again all rank lower than the average for hearing children of the same age. Of the total number of deaf children who performed this part of the test, 148 in all, 122 or 82.4 per cent, stood lower in motor efficiency than the averages of the records for children with normal hearing of comparable ages. The numbers are too few to warrant closer mathematical treatment, and indeed such treatment is unnecessary in the face of the data just offered. The reasons for this manifest motor inferiority have already been commented upon, and nothing requires to be added in this place.

Perception Time—

Again looking at Table XIV, in the columns headed "Perception Time," differences between the two classes of children, more pronounced than those shown in the 'Motor Time," are observed. The time required by deaf children to pick out the one hundred *a's,* on the average, ranges from almost twice that required by hearing children at the age of seven, to more than a third longer for the later years, fourteen and fifteen. For none of the age groups is the average perception time of children who have no hearing anything like as small as for children who hear normally, though the difference between the two groups progressively diminishes with increasing years.

Judging from this tendency of the difference in perception time of the two classes to become less with age, it is not un-

likely that were deaf adults and those with hearing examined and compared little difference would be discovered.

Considerable variability is exhibited by the average deviations of both groups, and a much greater amount of variability among the performances of the deaf than of hearing children. That the differences brought out by the averages of the two groups, however, is real, is conclusively shown by the character of the data shown in Table XV, where the number and per cent of deaf children whose standings are inferior to the averages of hearing children of comparable ages are given. Thus it is seen that at the age of seven years all deaf children possess a lower standing than the average for children who hear; at

TABLE XV.

"A" TEST—PERCEPTION.

SUMMARY OF TABLE XIV.

Relative number and per cent of Deaf children whose records stand lower than the averages for their respective ages of Hearing children.

	Motor time			Perception time		
Age	Number examined	Number lower	Per cent	Number examined	Number Lower	Per cent
7	9	9	100	7	7	100
8	16	11	69	14	12	86
9	15	9	60	15	12	80
10	26	20	77	26	23	88.4
11	15	15	100	15	11	73.2
12	9	9	100	9	9	100
13	17	12	70	16	12	75
14	9	7	78	9	9	100
15	20	18	90	20	15	75
16	12	12	100	12	8	66.7
All ages	148	122	82.4	143	118	82.5

eight, 12 of 14, or 86 per cent; at nine, 12 of 15, or 80 per cent; at ten, 23 of 26, or 88.4 per cent of the deaf require a longer time to pick out from among four hundred other letters the one hundred "a's" than the averages of their hearing companions for comparable age-groups. Concerning deaf children of all ages grouped together, we discover that 82.5 per cent, 118 of the whole 143 examined, have a longer perception-time than the averages of children of the same ages not thus afflicted.

When the number of "a's" not marked is taken into account

the results are in all essential respects comparable to those above. (See Table XIV). Deaf children not only require a longer time on the average to discriminate between the "a's" and the remaining letters of the alphabet when they are intermingled, as in the "A" Test, but they are also able to discriminate less accurately than children whose ears function normally, as is indicated by the greater number of errors,—"a's" overlooked, —and this deficiency likewise extends to all ages. Indeed, if we follow closely the results of the test, we are forced to say that deaf boys and girls from twelve to fourteen show relatively less discriminability than do those of the younger years.

The data regarding the A-Test are strikingly conclusive. Deaf children, on the average, are from two to three years less mature than hearing children of the same ages in the kind of ability that is called for in this test. And certainly this can not be attributed to the fact that a certain kind of skill is called for in the test, that the lack of school training from which deaf children suffer would fully account for. On the contrary, it is difficult to see how ordinary school exercises would conduce to rapid and accurate symbol discrimination, except in the general sense of leading the child to be more keen and alert in meeting any general and unfamiliar situation. From other tests and measurements, as well as from intimate association and observation, we are forced to conclude that a relative immaturity of from two to three years, as compared with hearing children, extends to all phases of the mental life of the deaf, and no doubt, too, its cause is to be found in the natural alienation which the minds of these children suffer by reason of the sensory barriers that have been set against their intermingling in the mental and social life of the communities in which they were born and are maturing.

Perception of Size.

Shot Test—

The second test, which deals primarily with perception, had for its object, as stated above, the determination of a child's sensitivity as measured by the ability shown in discriminating the sizes of small objects by the active exercise of the sense of

touch. This end was brought about by using a series of light canvas bags containing ordinary commercial shot of the following sizes: Nos. BB, B, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, dust shot.

The test had, like the foregoing test, grown out of the daily duties and needs of the Department of Child Study, and had been effectively used almost daily for four or five years, in the regular series of tests and measurements given to normal and abnormal children in the laboratory.

In conducting the test a child was first given a bag containing the median-size of the series, or shot number 6, at the same time another bag containing a size shot so large that ordinarily little difficulty would be encountered in perceiving the actual size-differences, after the child had rolled the shot-bag between the forefingers and thumb.

It was found that in the case of very young deaf children these ideas of comparison, "greater than," "less than," are rather late in developing, and teachers of the manual alphabet assert that such relational ideas are probably of all ideas the most difficult to appreciate and express in communicable symbols. With young children, especially those who had practically no language, considerable patience and perseverance was found necessary in order to have them get this conception of greater and less associated with or abstracted from the objects or qualities compared. Hence the necessity of using large differences at the beginning of the test. These considerations are equally pertinent to those perceptional tests dealing with the attempts to determine and express differences of weights, which are considered later on.

As soon as a degree of familiarity was gained by the child with the test and method of procedure, bags containing shot-sizes of smaller differences from the median-size, number 6, were presented and compared by him each in turn with the standard, until each size, both larger and smaller than the median, was tested and a judgment expressed on the sensed difference. In each instance great care was exercised by the examiner that there be no marks of identification on the bags examined, nor acquaintance with any particular way in presenting the bags,

nor any other means or measure of the child's devising or discovery which could interfere with the end desired, viz.: to determine the least difference, greater or less, than the median size, number 6 shot, that might be accurately sensed under controlled conditions.

Whether indeed the sizes of shot used in the series are graded uniformly or not, is a question which need not concern us, since it would be impossible to state, even though the actual differences between the variously numbered shot were equal, that the qualitative results obtained in the tests have absolute significance, e. g., that one child has twice or three times the sensitivity to tactual perception of size that another child possesses.

Below are given such measurements of the shot in diameters, in both the English and metric systems, as are actually necessary for a speedy application of the test:

It is admitted that this test is in itself a very complex process, involving not only the ordinary skin sensations of touch, but also calling into exercise the muscular and articular sensations. But this variety of sensory data, as well as further differentiations due to individual variations, such as differences in the thickness of the cuticle, and again lack of uniformity among the subjects who were examined in relying upon the component factors in the actual test of sizing—such, as for example, may be brought about by one person's dependence in the test upon pressing the shots between the fingers and thumb, while another relies upon lightly rolling the contents of the bags—will enter only remotely into the test from the point of view herein taken, which is to determine whether deaf children, on

Size 2	3.70 mm.	0.146 inches
Size 3	3.15 mm.	0.128 inches
Size 4	2.99 mm.	0.118 inches
Size 5	2.89 mm.	0.114 inches
Size 6	2.79 mm.	0.110 inches
Size 7	2.66 mm.	0.104 inches
Size 8	2.36 mm.	0.093 inches
Size 9	1.83 mm.	0.076 inches
Size 10	1.75 mm.	0.069 inches
Size 11	1.52 mm.	0.060 inches

the average rank higher or lower than hearing children in this very primitive and still in our day substantial mode of gaining information.

The results of this test are presented in Table XVI. In this the deaf children are compared directly with the hearing children of their respective ages. The table is divided into two main divisions, or parts. The main division on the left, for both deaf and hearing, indicates the portion of the experiment in which the standard is compared with shot of a smaller size, and the other main division has reference to that part in which the shot compared is larger than the standard. The sizes of the shot sensed are given at the top of each column from I to XII, and the results of comparative sensitivity under these headings show the per cent of children who are able to sense one, two and three size-differences.

As already indicated, differences in sensitivity of subjects do not always run parallel to objective differences, but it is, however, quite natural to make the inference that actual differences in the sizes of shot discriminated measure to a degree subjective differences in the sizing sensitivity of individuals, so that a child who can discriminate size 6 from size 7, or size 6 from size 5, has a keener sense of touch than a child who can only sense differences between two, three or more sizes.

Owing to the small number of cases, the girls and the boys, respectively, are divided into three groups; first, those children from 6 to 8 years; second, those from 9 to 12 years; third, those between the ages of 13 and 18 years. The ages of the groups are given in the first column of Table XVI, and in the second column is presented the number of cases examined in each group. For ready reference the recorded per cent of correct answers in each instance is marked by Roman numerals. Thus, in the third column, marked I, is recorded the per cent number of children who correctly sensed a difference between the sizes 6 and 7. In comparing, therefore, the deaf children with the hearing of like ages, in this particular test, we examine columns I and IV, VII and X, for records of their respective abilities in dealing with one size; columns II and V, VIII and XI, for differences of two sizes; and columns III

TABLE XVI.

PERCEPTION OF SIZE BY SENSE OF TOUCH.

Ages	No. of cases	Deaf children			No. of cases	Hearing children			Deaf children			Hearing children		
		I. Size 6 from size 7, per cent	II. Size 6 from size 8, per cent	III. Size 6 from size 9, per cent		IV. Size 6 from size 7, per cent	V. Size 6 from size 8, per cent	VI. Size 6 from size 9, per cent	VII. Size 6 from size 5, per cent	VIII. Size 6 from size 4, per cent	IX. Size 6 from size 3, per cent	X. Size 6 from size 5, per cent	XI. Size 6 from size 4, per cent	XII. Size 6 from size 3, per cent
							BOYS							
6....8	17	23.5	76.5	.....	5	60	40	.....	21	68.4	10.6	80	.....	20
9...12	26	42.3	42.3	15.4	31	60	40	.....	37.7	42.3	20	73	27	.....
13...18	32	56.2	43.8	.....	18	78	22	.....	56.2	40.6	4.2	67	28	5
							GIRLS							
6....8	10	40	60	.....	9	67	33	.....	40	60	.....	44	56	.....
9...12	18	61.1	38.9	.....	24	58.3	37.7	4	55.6	44.4	.....	54	42	4
13...18	28	60.7	28.6	10.7	17	70.6	29.4	.....	71.4	17.9	10.7	83	17	.....

and VI, IX and XII, for the results secured when the test involved actual differences of three sizes.

It is readily seen that at no age-group do so many deaf children accurately sense small differences as their hearing mates. Thus, in the 6 to 8 age-group of boys, 23.5 per cent only of the deaf children gave correct answers in attempting to sense a difference between sizes 6 and 7, whereas 60 per cent of the hearing children of corresponding ages were able to answer correctly (See columns I and IV), and in comparing sizes 6 with size 5, the deaf and hearing children stand, respectively, 21 and 80 per cents (columns VII and X).

Owing to the nature of the data in this Table, it is unnecessary to discuss any more than the recorded abilities of the children in dealing with differences of one size. (Columns I, IV, VII, X). It is interesting, nevertheless, to note that whereas 15.4 per cent of all deaf boys, in the age-group 9 to 12 years, are recorded as being able to perceive no smaller differences than three sizes (column III), there were no hearing boys of the same age who were unable to detect size differences of at least two.

It is, moreover, apparent that while sensitivity in this test increases with age, there is a much greater increase observed among the deaf boys and girls than among the hearing children of comparable ages, for we see that the per cent stands, respectively 23.5-42.3-56.2 and 21.-37.7-56.2 for the deaf boys, as against 60.-60.-78. and 80.-73.-67. for hearing boys (columns I, VII, IV, X), and 40.-61.1-60.7 on one-half of the Table, and 40-55.6-71.4 on the other half for deaf girls, as against 67.58.3-70.6 and 44.-54.-83. for hearing girls (columns I, VII, IV, X).

Besides a discussion of the differences due to increased ages of the deaf and hearing children, it is interesting to note whether our tables show any sex differences in this particular test of sensitivity. It is apparent, to speak in general terms, that deaf girls are more sensitive in this test than deaf boys, while, on the other hand, among the hearing children, the advantage in sensitivity lies with the boys. (See especially age-group 9 to 12 years, for deaf and hearing boys and girls). The reasons for this are, however, difficult to point out. It may,

indeed, be due to some fundamental difference between deaf and hearing children; again differences of training and daily experiences may affect their skill in reacting in this test, or we may have to fall back on the observation that the number of deaf children in each age-group is so small as to preclude positive statements on this score.

For the very reasons, however, that the number of cases is so comparatively small, and the data of the sizing-test are presented in terms of ranks of individuals, it is of some interest to turn to the additional data subjoined, which show the number and per cent of children who are able to size differences as

TABLE XVII.

SIZING TEST (ACTIVE TOUCH).

Showing the number and the per cent of children who are able to sense differences as indicated, the children being grouped without reference to age.

	No. of cases	I. Size 6 from size 7	II. Size 6 from size 8	III. Size 6 from size 9	IV. Size 6 from size 5	V. Size 6 from size 4	VI. Size 6 from size 3
Deaf boys, all ages.....	75	33, or 44%	38, or 51%	4, or 5%	32, or 43%	35, or 47%	8, or 10%
Deaf girls, all ages.....	56	32, or 57%	21, or 37%	3, or 6%	34, or 61%	19, or 34%	3, or 5%
Boys and girls.	131	65, or 50%	59, or 45%	7, or 5%	66, or 50%	54, or 41%	11, or 9%
Hearing boys, all ages.....	54	35, or 65%	19, or 35%	.....	40, or 74%	12, or 22%	2, or 4%
Hearing girls, all ages.....	51	32, or 63%	18, or 35%	1, or 2%	32, or 63%	18, or 35%	1, or 2%
Boys and girls.	105	67, or 63.8%	37, or 35.2%	1, or 1%	72, or 68.5%	30, or 28%	3, or 3%

indicated in Table XVII, where the children are grouped without reference to age. In this Table XVII it is more than ever apparent that deaf children, as a group, are not so sensitive as hearing children. Giving exact statement, it is seen that only 50 per cent of the deaf children sensed the smaller size differences (See columns I and IV of Table XVII), whereas 68.5 per cent, or at least 63.8 per cent of the hearing boys and girls, accurately detected a difference of one size. Of course, the qualification should be made that the number of children in the different age-groups are not equal. However, because there are more children in the older age-groups than in the younger, and again since sensitivity is observed to increase with age, whatever advantage there is, lies with the deaf children.

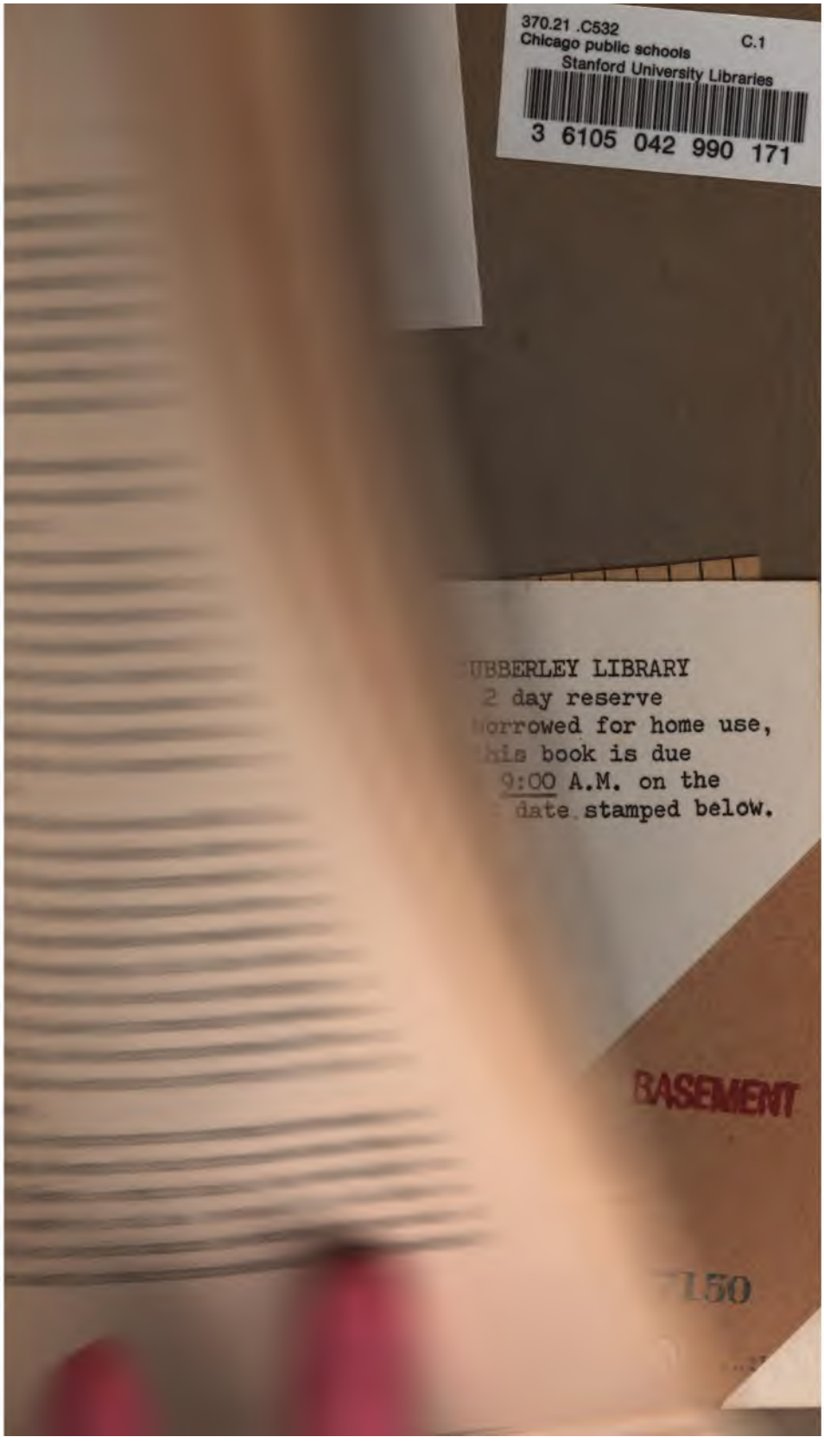
Again, by reason of the further groupings of children

which this table makes, the sex differences of the deaf and hearing children, already alluded to, become more significant. Taking the deaf first in order, it will be seen that 44 per cent of the boys gave correct answers to the test on one side, below size 6, and again 43 per cent of the whole group were correct for a difference of one size above size 6, whereas the deaf girls gave 57 and 61 per cent, respectively, correct. The deaf girls, as a group, although inferior to their hearing sisters in sensitivity, are not so much below as the deaf boys in this particular. The hearing boys stand 65 and 74 per cent for one point's discrimination, while 63 per cent of the hearing girls, as a group, show ability to perceive differences of one size above or below the standard. Moreover, from internal evidence in the table, the deaf and hearing boys seem more variable in abilities than the hearing and deaf girls.

Least Noticeable Differences in Lifted Weights.

Turning now to the third perception test, we come to consider the child's power to discriminate small differences in lifted weights, where the lifting or hefting is done by a free, full-arm movement, such as occurs when a child passes alternately from one weight to the other in lifting them from a table, upon which they have been placed.

For the test series small wooden bottles of uniform size and dimensions were employed. So far as external appearances go, they could not be easily distinguished the one from the other. The bottles were loaded to the required weight with a filling of shot. They were then packed with paraffin and cotton, so as to prevent any movement of the contents within, after which they were carefully sealed. The series ran at intervals of two grams from a weight of 8 grams to one of 32 grams. In order it stood, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32 grams. With the 16 gram weight, which was used as a point of departure, or standard, weights heavier and lighter were compared; the 16 gram weight and the one heavier or lighter than it, having been placed upon a table before the child, and he asked to heft them, one after the other, and to indicate which of the two was the heavier. Care was taken, however, to keep the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concerned. Indeed, since the figures are, for the most part, mutually exclusive, in casting up *age, sex* and *group* comparisons, we need consider only the data found in the columns indicated by the Roman numerals *I, IV, VII and X.*

Examining critically now the data in the columns indicated, it is to be noted that for the younger years (6 to 8) deaf boys are rather strikingly inferior to their hearing mates in this sense, while the converse holds in the case of the girls. In the 16 and 18 gram set, 66.7 per cent of deaf boys were able to make the discrimination invariably, as against 80 per cent of the hearing boys. The figures for deaf and hearing girls are 66.7 per cent and 44.4 per cent, respectively. In the 16 and 14 gram set again 66.7 per cent of the deaf boys always rendered correct judgments, while 100 per cent of the hearing boys were able to do so. For deaf girls the figure is 71.4 per cent, against 66.7 per cent for hearing girls. The number of hearing children, especially at these ages, is unfortunately small, so that too much weight cannot be attached to the results.

In the next age-group (9 to 12 years) the numbers are larger, and the conclusions consequently a little more reliable. Deaf boys now rank in muscular sensitivity above hearing boys, the per cents being, for the 16-18 gram pair 88.4 and 74, respectively, for the deaf and hearing boys, and for the 16-14 gram pair, 77.3 and 72, respectively, for the groups considered. Between deaf and hearing girls of this age-group, the differences are discovered to be inconsequential. The figures for the 16-18 gram pair are 53.3 and 54.0 per cent, respectively, and for the 16-14 gram pair of weights, 64.2 and 58.3, per cent.

The groups of adolescents (13 to 18 years) are not so large; but differences between the groups in the mental attitude in which the test would be approached, ought to be less significant than for the younger ages. (If this factor actually enters into the test.) So far as the results go, no significant differences in muscular sensitivity between deaf and hearing boys or deaf and hearing girls stand out. Deaf boys rank lower in the 16-18 gram set than hearing boys, as is shown by the relative per cents who invariably rendered correct judgments, 60 per cent of the deaf and 66.7 per cent of the hearing boys, but this

TABLE XVIII.

PERCEPTION OF WEIGHT (ACTIVE).

Ages	No. of cases	Deaf children			No. of cases	Hearing children			Deaf children			Hearing children		
		I. 16 gms. from 18 gms., per cent	II. 16 gms. from 20 gms., per cent	III. 16 gms. from 22 gms., per cent		IV. 16 gms. from 18 gms., per cent	V. 16 gms. from 20 gms., per cent	VI. 16 gms. from 22 gms., per cent	VII. 16 gms. from 14 gms., per cent	VIII. 16 gms. from 12 gms., per cent	IX. 16 gms. from 10 gms., per cent	X. 16 gms. from 14 gms., per cent	XI. 16 gms. from 12 gms., per cent	XII. 16 gms. from 10 gms., per cent
								BOYS						
6....8	15	66.7	33.3	.....	5	80.0	20.0	.....	66.7	20.0	13.3	100.0	.....	.....
9....12	22	88.4	11.6	.....	32	74.0	26.0	.....	77.3	18.2	4.5	72.0	28	.....
13....18	25	60.0	36.0	4	18	66.7	33.3	.....	64.0	32.0	.....	61.0	33.3	5.7
								GIRLS						
6....8	9	66.7	33.3	.....	9	44.4	44.4	11.2	71.4	28.6	.....	66.7	33.3	.....
9....12	15	53.3	46.7	.....	24	54.0	46.0	.....	64.2	35.8	.....	58.3	41.7	.....
13....18	23	78.3	21.7	.....	17	70.6	29.4	.....	69.6	26.1	4.3	70.6	29.4	.....

inferiority is compensated for in the 16-14 gram pair of weights, where the per cent of deaf who sensed a difference was 64 as against 61 for the boys with hearing. In the case of the girls, the deaf have a slight advantage in the 16-18 gram pair, 78.3 per cent making correct judgments, as opposed to 70.6 per cent of the hearing girls, but with the 16-14 gram set 69.6 per cent of the deaf girls invariably gave correct replies and 70.6 per cent of the hearing girls.

Looking for differences between the boys and girls as regards sensitivity for lifted weights, among deaf children it is discovered that for the younger years, the sexes do not differ very significantly, the same per cent of boys and girls sensing a weight difference between 16 and 18 grams, and only a slight advantage being shown in favor of the girls in the 16-14 gram set. Among hearing children of the same ages, on the contrary, the boys show up markedly better than the girls, 80 per cent sensing the difference in the 18-16 gram set, and 100 per cent in the 16-14 gram set, as against 44.4 per cent and 66.7 per cent, respectively, for the two sets, in the case of the girls.

Comparing the sexes in the second age-group (9 to 12 years old), we find the boys uniformly better both as regards deaf and hearing children. The figures run as follows:

	Deaf.		Hearing.	
	16-18 set.	16-14 set.	16-18 set.	16-14 set.
	Per cent.	Per cent.	Per cent.	Per cent.
Boys	88.4	77.3	74.0	72.0
Girls	53.3	64.2	54.0	58.3

Conditions are reversed when we turn to the older group of boys and girls, those between the ages of 13 and 18 years, as may be seen from the following summary:

	Deaf.		Hearing.	
	16-18 set.	16-14 set.	16-18 set.	16-14 set.
	Per cent.	Per cent.	Per cent.	Per cent.
Boys	60	64	66.7	61.0
Girls	78.3	69.6	70.6	70.6

Thus, although some sex differences were discovered, when age groups were considered separately, taken all together the group tendencies counteract one another, so as to obliterate any

conclusive evidences of such tendencies in one direction or another.

Looking for differences in sensitivity that might come with increased age, the data also offer nothing very promising. The 16-18 set does show such a tendency in the case of the hearing girls, but the exact converse is shown, with both this weight set and the 16-14 gram set in the case of the hearing boys. The data for the deaf are altogether too irregularly distributed to warrant any general conclusion. A larger representation in each age-group, however, might bring out some decided evidence of improvement in the *weight* sensitivity with age, but it is equally likely that the responsible factor is the elementary nature of the test.

PERCEPTION OF WEIGHT (ACTIVE).
BRIEF SUMMARY OF TABLE XVIII.

	No. of cases	16 grs. from 18 grs., per cent	16 grs. from 14 grs., per cent
Deaf boys, all ages	62	71	69.3
Deaf girls, all ages	47	68.1	68.1
Boys and girls (deaf)	109	69.7	68.8
Hearing boys, all ages	55	72.9	70.9
Hearing girls, all ages	50	58.0	64.0
Boys and girls (hearing)	105	65.7	67.6

In the foregoing discussion, because the numbers at each age are so small, the children were placed in three groups, and, to a degree, the disadvantages due to small numbers were overcome, though, to be sure, not wholly obviated. There are several advantages, therefore, in comparing the deaf boys and girls as a whole, irrespective of age, with hearing boys and girls under like conditions, as well as to compare our deaf children as a whole, with their hearing companions. The results of such groupings are presented in Table XVIII (Summary), and we accordingly see that, in sensing a difference of two grams between two lifted weights, 71 per cent and again 69 per cent of the deaf boys gave correct responses, as against 73 per cent and 71 per cent of the number of hearing boys examined. Further, 68 per cent and again 68 per cent of all deaf girls correctly sensed a difference of two grams, whereas only 58 per cent and 64 per cent of the hearing girls were equally sensitive. Finally,

in the group representing boys and girls, we see in comparing the deaf children with hearing children in this test that 70 per cent in one instance and 69 per cent in the other case, of all the deaf girls examined, accurately sensed the actual differences of two grams in the weights presented, whereas 66 per cent and again 68 per cent of the whole number of hearing girls examined, were able to note the same differences. Deaf girls, therefore, as a whole, irrespective of age, rank better than their hearing sisters, but, on the contrary, deaf boys rank more poorly, and, taking boys and girls together, irrespective of age, while the advantage lies slightly with the deaf, their superiority over their hearing companions is not sufficiently marked, considering the paucity of numbers, to warrant us in asserting that the difference is real.

Memory.

Among the different materials employed for testing the immediate sense-memory, the ordinary Arabic numerals must be considered among the best, both from the point of view of convenience and reliability of results. Numerals are symbols used in our civilization, and inasmuch as they are in themselves relatively non-significant, they can be employed readily in making a comparative study of one kind of memory. A numeral is not liable to have more associations with one individual than with another. To test the visual sense-memory, cards on which were placed in rows the ordinary Arabic numerals were held before the child, after which the cards were removed and the child was required to reproduce the numerals which were seen, in the exact order in which they appeared on the cards, either orally or in writing. In order to avoid groupings the child read the numerals from right to left, and the greatest number which he could accurately reproduce was considered a measure of his visual sense-memory. In the second part of the test the numerals were repeated to the child by the experimenter, care being taken that there should be no rhythm which could induce groupings; and the child reproduced the numerals as before.

The test thus consisted of the two parts (1) pure visual sense-memory, (2) indirect visual-memory, read from the lips of the experimenter. This latter also afforded a test of the

child's ability to read unrelated word-symbols from the lips of the speaker.

TABLE XIX.
MEMORY SPAN.

Age Yrs. Mos.	Number	Visual		Lip reading
		Deaf	Normal	Deaf
7.....6	10	3.3	5	3.2
8.....6	13	3.3	5	3.0
9.....6	13	3.7	6	3.1
10.....6	17	4.1	6	3.7
11.....6	12	4.4	6	4.0
12.....6	7	4.7	7	4.4
13.....6	12	4.8	7	4.2
14.....6	12	5.2	7	4.7
15.....6	17	4.9	7	4.3
16.....6	6	5.7	7	4.3
17.....6	4	5.5	7	4.7
18.....6	2	5.0	7	4.0
19.....6	2	5.0	8	5.0

In Table XIX are given the memory spans of deaf and normal hearing children in parallel columns. It is seen that whereas the hearing child of from seven to eight years has, on the average, a memory span of five numerals, the deaf child has a memory span of but three numerals, and while the hearing children from 12 to 19 years of age have, on the average, a memory span of seven numerals, the deaf children can remember but four or five. It is further seen that there is but a slight superiority when the numerals are directly seen in comparison with the indirect reading, or reading from the lips. This offers a suggestion that lip-reading has kept pace with the child's general development.

Taking all these tests and observations together for the purpose of estimating the mental status of the deaf children, we see that it is possible to get a general view of their comparative abilities with respect to particular mental powers. But when these mental functions are all taken together they do not exhaust the content of such a highly complex thing as mentality. It is necessary always to bear in mind what we really mean in everyday life by mental capability or mentality. Is it the ability to speak, to read, to write, to follow directions, carry on ordinary functions of life without assistance, or does it mean the capacity an individual has to improve by training and practice and the relative facility with which training can be accom-

plished? With the deaf child we necessarily must place more emphasis on the latter, i. e., the teachableness of the individual. Sometimes he cannot speak, read, write or follow directions as given by us, because he lacks the symbols—language, the medium by which we, as hearing individuals, indicate directions. And until he learns the symbols and the meanings attached to them it is impossible to test him by such standards. Such a procedure would be as unfair as to give the unclassified man directions in Greek, and then classify him as mentally deficient because he was unable to follow them.

Therefore, the chief criterion used in testing the mentality of the children in the deaf rooms was their amenability to training. The question put to ourselves was this: Has the child sufficient mentality so that, with the training he shall receive in school, he will be partially or wholly self-supporting when he has reached maturity, or will he likely become a ward of the State?

Such a criterion naturally gives us three somewhat distinct classes, which may be called:

1. Mentally Normal: Those who will be wholly self-supporting at maturity.
2. Slightly Sub-Normal: Those who will not be, in all probability, wholly self-supporting when they attain to manhood and womanhood, but may require some external direction in any occupation which they may take up, or in the general conduct of life.
3. Those who will probably require direction and care, and hence must be regarded as wards of the State.

We find, then, that as thus classified, the deaf children are distributed in the following order, and these ratings are made partly on the basis of the personal judgment of the examiner—being the result of an hour's careful inspection of the child's work—but more particularly based on the child's performance in the mental tests given:

Number of Normal Mentality	173
Number Slightly Retarded or Sub-Normal	11
Number Mentally Defective, or of those who do not give promise of being at least partially self-supporting at maturity	0
Total number examined	184

It is thus seen that of the total number of 184 children in attendance at the deaf schools, only 11, or 6 per cent, are so backward mentally that they do not give hope of being able to support themselves independently after they have reached the ages of manhood and womanhood, and further, there is not a single individual whom it seems the State will have to take over as a ward.* It may be noted that this number, 6 per cent, of the group of deaf children who are accounted as Sub-Normal, is considerably higher than we find among all school children, among whom 5 or 6 per thousand are regarded as distinctly Sub-Normal in the very technical use of the word. This rather large number is doubtless intimately related to, if not, indeed, caused by, the diseases and disorders that bring about impairment of hearing in such a large number of the deaf children.

*This does not mean that there are no mentally-defective and feeble-minded children among the deaf in Chicago, but that in the preliminary examination of deaf children, by this Department, for admission to the rooms for the instruction of the deaf, the parents of those who were too low a grade of mentality to profit by such instruction as the public schools afford, were advised to send their children to institutions where special province is the care of such cases. In no case were feeble-minded children permitted to enroll in the classes for the deaf.

SUMMARY AND SUGGESTIONS.

In making a brief resumé of the study heretofore presented in detail, the attempt will be to give the results in barest outline only and then add the suggestions which come to mind as a consequence of these results.

It was pointed out that the intimate relation between the mental and physical life of children made it necessary, if the study should be full and complete, that these aspects of the child's life should receive careful consideration. Further, by way of introduction, it was indicated that owing to the extreme timidity and narrow social life of deaf children, time, patience and skill were required in order to elicit any responses which would be indicative and characteristic of this type of children.

The hearing ability of the deaf was found to vary by degrees from absolute silence and insensibility to any sounds whatever, to a condition of semi-deficiency where the auditory acuity was too defective for the child to carry on his work in the grades with hearing children, i. e., it was found that deaf children do not form a distinct group. There are all grades of hearing power and the classification might better be based on the use which the power of hearing serves in social communication.

It was found that only thirty-two per cent of the whole number of deaf children were totally deaf; nineteen per cent were found to be practically deaf, that is, they gave no hope of ever being able to hear the human voice, even with the aid of mechanical instruments. There were thirty per cent who were unable to hear speech, but could hear loud noises. This and the next group, which contains fourteen per cent, who could hear loud speech, form a class which may for certain purposes be grouped together. In comparing the intensity of the noise which some of these children are able to hear, with that which some adults, whose hearing became impaired after maturity, are capable of appreciating and responding to intelligently, it is found that there are deaf children who hear no speech at all whose absolute hearing power is superior to that of some of those who hear and

depend on speech. This difference in speech-hearing ability seems to be due entirely to the absence of the habit of attention to the significance of sound-sensations on the part of deaf children. These considerations offer the suggestion that if some means were employed of intensifying speech-sounds and in this way create the habit of attending to sound sensations of speech, in many cases the hearing of the deaf children might be so improved that to a considerable extent they could be made dependent on hearing in carrying on social intercourse. Of course, such a habit could not be developed short of many months of training and for this reason we found it impracticable to make the test of the value of any apparatus on the market for this purpose. Different devices of hearing apparatus are very highly recommended, but we are not aware that any of these have been extensively tried anywhere in Chicago. Not having given any apparatus for developing the power of hearing a careful and crucial test, the Child Study Department does not therefore feel justified in recommending any particular form or device, but we do think that some apparatus should be given a trial, especially since twenty per cent of all children in attendance at different rooms for deaf children give the hope of having their hearing sufficiently improved to hear conversation.

Passing to the part of the investigation relating to the speech and speech-reading of the deaf, the main consideration in relation to the time that had been spent in acquiring it, was the character of the speech. Necessarily the character of the deaf child's speech depends on the amount of training he has received. This aggregate of training, in a great majority of cases, can be measured by the time the child has been in school. Waiving all consideration of those children who possess sufficient hearing to enable them to speak in the natural way and those who lost their hearing after they had learned to speak, thus limiting ourselves to those who are born deaf and to those who lost their hearing early in life, we find that after a period of three years in school, twenty-five per cent have speech which is normal, or nearly so; there are fifty-three per cent whose speech is defective and twenty-two per cent in whom speech is practically wanting, i. e., less than fifty words.

To repeat here, for the sake of clearness, a statement made in the body of the report, when we speak of a deaf child's speech as normal, we mean that his articulation and tonal quality are good, but not that his range of vocabulary is equal to that of a hearing child of the same age. A latitude in this particular must be allowed of from three to five years. After a school period of five years we find that forty-two per cent of those born deaf or those who lost their hearing early in life, have speech which is normal or nearly so, fifty-eight per cent have speech which is more or less defective and not a single individual was found who could not intelligently talk at least fifty words. At the end of seven years of school training forty-seven per cent were found to have normal speech and fifty-three per cent with speech somewhat defective. Only four individuals had been in school as long as ten years. Of these one had some hearing; the other three, congenital cases, were found to have speech which was normal.

From the foregoing it appears that at least where conditions obtain as they do in our day schools for deaf children, more than three years of training is necessary in order that the average deaf child shall acquire speech, but that almost every child (so far as our results indicate) is able to learn the use of speech and speech-reading after a school period of five years.

It is unfortunate that the school has no control of the home and social conditions of children and especially the deaf. If it were possible to control, in a measure, the food, rest, exercise and language environment of the deaf child, and if it were possible to enlist the co-operation of parents in employing school methods of communicating with their children, whatever these methods may be, the acquirement of any language would be greatly facilitated. In fact, it is found to be so with the method now in use, in those homes where parents are eager to learn and adopt the school room practices. Children from better homes, it was observed, were from two to four years in advance of those who came from less favored homes. However, it is doubtful whether many consider the time element as after all the factor of paramount importance. Probably the most vital consideration is whether the great majority of deaf children or all deaf chil-

dren can acquire speech even after ten years of training, and if (as shown by the results of our investigations) all children, after they have been in school from five to ten years, do gain a sufficient mastery of speech to carry on intercourse with hearing people, then the question arises whether the oral method be of more service to them than the manual in the succeeding forty or fifty years, while they are earning a livelihood and are getting the most out of life that it has to offer. But as before mentioned, the problem of the relative value of oral or manual language as a means and medium of intercourse in the social and industrial world is one which it was impossible for us to evaluate and on this account we prefer to leave it untouched.

There are, however, certain suggestions that refer more specifically to those who are engaged in teaching the deaf, which we feel ought to be made. Where oral speech is to be taught, it is undoubtedly the part of wisdom to take cues from nature's ways of dealing with normal hearing children. Every effort should be made to ascertain as early as possible in the life of these children the nature and degree of deafness, together with the causes which brought about the defect, so that perchance something may be done to remedy or improve the conditions. In the case of the congenital deaf and those who lost their hearing before the middle of the second year, the ideal procedure would be to have instruction begin as nearly as possible after the time that speech tendencies normally develop.* It is one of the laws of instinctive behavior that if tendencies to activity are not utilized at the time they appear in nature's program, they fade and the activity must be developed anew at the expense of considerable effort, and there is no reason why this does not apply to speech as well as to other human activities. Whether kindergartens should form a part of the public school system of education for the deaf is a matter pertaining wholly to public policy and administration, but certain it is that those few children now in the deaf schools who have had the advantage of early instruction are far in advance of the less favored children in their power to adjust themselves to the educational forces at work in our social life.

*Cf. Kerr Archives of Otol. 33: 129.

The important part which hearing plays in the acquiring of speech is another element that cannot be too much emphasized. By all means advantage should be taken of the hearing power which the child has, however little this may be. Especially important is this in the case of those children whose hearing became impaired through disease after speech had been acquired. Unless the hearing factor is utilized, there is a tendency for confusion to result from the inability of the child to distinguish the hearing images from the imperfectly formed visual images. (Of course reference is here made only to language images.)

In the matter of sight, which is so overwhelmingly important in the life of the deaf child instructed in the oral method, who must depend on this sense almost entirely, the investigation showed very happily that the visual acuity of the deaf is on the whole as good as that of the hearing children. Nor is the relative number of those suffering from decidedly defective vision greater in the former group than it is in the latter. The suggestion is pertinent here that the eyes of the deaf children should receive frequent testing so as to obviate any permanent impairment of vision which may result in consequence of eye strains.

In comparing the stature of the deaf with that of hearing children, it was discovered that both deaf boys and deaf girls were, on the whole, shorter in stature for corresponding years, and both sexes among the deaf have shorter bodies in proportion to the total height, than hearing boys and girls. With respect to weight, deaf boys were slightly lighter, on the whole, than their hearing fellows, but on the other hand, deaf girls were slightly heavier, age for age, than hearing girls. Deaf children in general, of both sexes, were found to have smaller heads than normal hearing children, when as a criterion of size, the length-breadth product is employed. On the average, too, they were more brachiocephalic (broader headed.)

The most striking comparative inferiority of the deaf was pointed out in connection with the data on lung capacity. Deaf boys as a group, it was seen, stood about on a par with the twenty-five percentile group of hearing boys; and the deaf girls had about the same rank as the thirty-five percentiles of their hearing sisters. In general average, deaf boys and girls rank

seventy-five and eighty-five per cent, respectively, of the norms for hearing children of their respective sexes. It is thus seen that the effect of sedentary life is especially marked in diminishing the vital capacity of the deaf. Of course, speech normally has a tendency to develop lung power, but the deaf child suffers from the deprivation of this as well as from the deficiency of physical exercises, so that his blood is insufficiently aerated and oxydized, giving rise to anaemic conditions with all their attendant evils.

Taking as a measure of strength, the ability to compress an adjustable dynamometer, with each hand separately, it was found that deaf boys, although slightly stronger than hearing boys during their younger years, with the on-coming of adolescence, showed a marked inferiority, and this was equally palpable in the case of the less used and stronger hands. Between deaf and hearing girls no significant difference stood out, and this, as previously intimated, is but natural to expect. Hearing girls are much less given to activity, as a whole, than hearing boys, but that between hearing and deaf girls is probably not such as to carry significant weight. Further, in the way of indicating strength differences between the two groups of children, may also be employed the grip indices, i. e., the fraction which the weaker hand is of the stronger in each individual case, on the average. Here again, there was found to be no significant difference between the grip indices of deaf and hearing girls; on the contrary, deaf boys were found to be less ambidexterous during the pre-adolesent years, but more ambidexterous after the age of maturing, than hearing boys.

Taking as another measure of bodily efficiency, the quickness with which a child is able to perform voluntary co-ordinated movements as determined by the number of taps which can be made in thirty seconds, it was found that at no age was the average for deaf boys equal to the average of hearing boys, with the right hand, and with the left hand the difference in motor ability in favor of the hearing boys is still more apparent. Deaf girls in the case of both hands, were found strikingly inferior to hearing girls, and at no age is the average performance of the deaf significantly higher than that of their hearing sis-

ters. It was further noted that both deaf boys and deaf girls of 12 years and older more nearly approached the standings of hearing children in tests of motor ability than the deaf of younger years. Furthermore, while the grip indices showed deaf boys approaching maturity only, to be more ambidexterous than hearing boys, the motor ability indices showed that the deaf of both sexes, at all ages, are more ambidexterous on the average than their hearing companions. It may be added, too, that this latter index is, all in all, a better criterion of manual selectiveness than that of grip. The relative standing then, of deaf children as a class, in comparison with hearing children, was found to be even less favorable, where rapidity of movement is involved, than was apparent in the measurements of stature and weight, and only slightly better than their relative standing in lung capacity.

By way of accounting for the more favorable showing of the deaf children of more mature years, it was pointed out that there seemed to be some intimate relation between an increased variety of mental content and growth in motility, that is, according to this view we should expect, with increased mental training, a greater degree of motor activity. By this indirect means, therefore, the outflow of significant motor energy is enhanced. But the problem of increasing bodily efficiencies should be attacked directly. Certain provisions should be made to develop the bodies of the deaf children. Their tendencies to be inert and inactive should be counteracted or overcome. Considerable encouragement or stimulation is necessary to bring about continual increase in bodily activity in order that their movements may approach that free and unstrained type of the normal hearing children in their plays and home life. These large, free and easy movements have, besides the advantage of developing and maintaining the physical tone, the added value of furnishing stimulation to mental growth. On this account, deaf children should be encouraged to participate in the spontaneous out-of-door games of hearing children as far as they are able, i. e., the plays of the door-yard and of the street. Likewise, the periods of desk work in the schools, especially for children under 12 years of age should be as short as possible and the emphasis should be placed

upon the gross physical activities which are called into play in their marches, games and constructive arts.

In turning to the more distinctly mental features of the investigation, the results show the deaf to be equal to normal hearing children in the more elementary functions, such as imitation and suggestibility, which are, to be sure, extremely elementary and fundamental in character, but in the higher functions they were found to be generally inferior. In the first test, for which measurements were received—the "A-Test"—deaf boys as well as deaf girls of all ages, are found to rank from three to four years below hearing children, both as regards the time of discrimination and accuracy, in selecting one symbol from others of its kind in a page of printed matter. A smaller per cent of deaf children of both sexes than hearing children were found to be able to discriminate the smallest differences in size, and in hefting or sensing small differences in weight, probably no differences obtain between the two classes of children. Deaf boys were found to be slightly inferior to hearing boys in general, whereas deaf girls were discovered to be generally superior to the hearing. Discriminations made in the latter test (weight) are based on shocks of differences into which a comparison with a conscious standard weight-image is not thought to enter, in spite of many contentions to the contrary, that is, the sensory data are relatively less complicated than are those which enter into the sizing test, and hence the weight test, like those of imitation and sensibility, would be less liable to indicate individual differences than the test calling for discrimination of size.

With regard to immediate sense-memory, which was the only aspect of that important function which it was found practicable to employ on these children, it was pointed out that at all ages, the memory span of the deaf averages about two numerals less that that for hearing children, about the same relative inferiority that was observed in the case of the "A-Test." This inferiority of the deaf on the mental side perhaps means no more than that the child is from three to four years less mature than the hearing child of his age, and that his date of maturing will be correspondingly delayed. It does not necessarily mean that adult deaf individuals will be much inferior in

mental comprehension and initiative to hearing adults. Indeed, this mental retardation may be due to conditions in training, and were the deaf child's instruction begun in infancy instead of at six years, the difference might be reduced or even eliminated.

The problem of determining the number of deaf children who are sub-normal, using a relatively pure mental standard, presents difficulties which we find it impossible to meet. One can never determine just how much training a deaf child has had. It is found much more feasible and practicable to employ as a criterion the individual's susceptibility to training. On this basis the investigation showed that there are but 6 per cent of those in the rooms for deaf children who do not give promise of being able to at least support themselves on reaching maturity. And even these 6 per cent of the total number, will be at least partially self-supporting; that is, able to earn a livelihood under direction. Further, not one was found whom it would seem that the State must eventually take over as a ward.

The question of grading the deaf children is one that merits consideration, and it seems highly desirable to have the children well classified. Although individual instruction undoubtedly has many advantages over class work, nevertheless the stimulus that comes from companionship with their mates in a class exercise has a decided educational value. This association without doubt goes far to incite, continue and cultivate tendencies to express and communicate ideas. It would also tend to prevent the too close dependence of children upon the teacher's initiative, and to avoid the narrowing effects ensuing from their fitting responses only to that which is expected or demanded of them. In day schools where the children are dispersed over the city, proper classification is of course a puzzling problem.

Commendable efforts have already been made in the public day schools for the teaching of the deaf in Chicago, in establishing within certain districts of the city centers where a considerable number of deaf children are collected, making it possible to grade and classify children according to age, natural aptitude and school experience. But there is the additional desid-

eratum of a proper Course of Study for the deaf. As in the case of instruction of hearing children, there should be provided for deaf children, adapted to different years of their school training, a certain definite body of information with which teachers should be expected to make the children conversant. This is especially important in view of the fact that it becomes necessary sometimes to transfer a deaf child from a school in one part of the city to another. It thus ought to be possible to have a certain repertoire of words and activities which all deaf children should acquire during their first year of school life, and in the same way for the following three or four years. The saving of the teacher's time and energy in duplicating work already done, in discovering the amount and character of the previous training of the child, would be considerable, and a decided step in advance would have been taken in the direction of a proper grading of the deaf.

In offering the above experimental study of the comparative physical and mental life of the deaf there are, of course, many psychological and educational problems which have not been touched upon. The foregoing is, however, presented with the hope that it will throw considerable new light upon a problem which has hitherto been approached only from the standpoint of theory and personal experience.

APPENDIX.

HISTORICAL NOTES.

So far as the Department of Child Study is aware, no scientific study has ever been undertaken with the same object in view, similar methods of procedure and with comparable groups of children. Reference should, however, be made to Dr. Love's studies * of fifty-four deaf children of the Glasgow Institution in 1896, and their reported standing as compared with boys of corresponding ages in the public schools of that city. The statistics on the physical characteristics of the children (grouped at ages 15, 13, 11 and 9 years respectively), relating to height, weight, circumstances of head and chest, seem to show that they compare favorably with the normal hearing children of corresponding ages, but the numbers are so small as to render it very unsafe to generalize the findings on this special group or to compare the results obtained with those of other workers. The same is true in referring to the mental qualities of the deaf children, with the added stricture that no ultra-school tests were given. Classifications of mental status were based on observations and estimates of the teachers and no check is presented to us of the personal equation of the observers whereby comparisons can be made between the mentality of these children and any other selected group of deaf children.

Again one must note Binet's work ** on the head measurements of deaf children at the National Institute of Asnières, France, in 1901. To these cephalic measurements should be added, as indeed they were incorporated by the author, the statistics previously published by the attending physician to the institution, Dr. St. Hilaire *** on height, weight, lung capacity, thoracic perimeter, strength of hand grip, circumference of head, in every item of which the deaf children are recorded as in-

*J. Kerr Love, Deaf Mutism, 1896.

**Alfred Binet, Les Proportion du Crane chez Sourds-Meuts L'Annee Psychologique, VIII, 1901; 385.

***Etienne Saint-Hilaire, La Surdi-Mutité, Étude Medicale, 1900.

ferior to the normal hearing children of the same ages. The specific object of this study was to note cephalic changes in a comparison of the three groups according to age of the children examined. The shape of the heads of deaf children between five and seven years was compared with the group nine to eleven years, at which time the transformations evidenced by the various diameters were pronounced, and these two groups were, in turn, compared with the older groups, ranging in age from fifteen to seventeen years. The comparative status of the deaf and hearing children in these French institutions will be referred to on a later page of this study. Any attempt to draw direct comparisons between groups of children must always be open to certain reservations, but in this case it may be noted at once that the deaf children attending the public day schools of Chicago are a specially selected group, due to the preliminary entrance examinations to these rooms which are given by this department.

Dr. Ferrai, in 1902, made some comparative psychological experiments * on twenty-four deaf children and twenty-two normal orphaned children from socially comparable institutions in Rome. The recorded results of the mental tests which dealt, it should be noted, only with simple and complex memory, ought to be of the greatest importance, but unfortunately they are not of such a character as to show anything more than differences due to training and environment. The general conclusions exhibit pretty much what might be expected from the material presented—that the deaf-mutes have a memory much inferior to hearing children, and give evidence of much greater improvement and progress during a definite period, because indeed, there is greater possibility of rapid improvement in their case before the psychological limits are reached with the subject matter at hand.

The study made by Schaefer and Mahner (**) of four deaf, four blind and four normal hearing children is likewise of interest, mainly for the attempt to establish direct comparisons between these special and variant groups of children. The

*Dr. Carlo Ferrai, Recerchi comparative Psicologia sperimentale sui sordo muiti. Intern. Archiv fur Schulhygiene. Band I. heft 4.

**Ztsch. f. Psych., 38; 1905, pp. 1-23.

results are, however, vitiated by the fact that none of the deafs were congenital, but became afflicted between the ages of 2 to 9 years. Furthermore, the attempt to make comparisons between the deaf children at each age and the normal hearing children two years younger may have seemed suggestive for the special group of institutions investigated, but certainly cannot be supposed to yield results susceptible of very general application.

The somewhat intensive study of Dr. Decroly and Mme. Degand on visual memory of seven deaf children is in a measure deserving of special mention for its insistence upon specifically psychological methods of attacking the problem of the development of the deaf. The deaf children who were compared with normal hearing children are reported as not of equal ages in each instance, and consequently no true index of the rate of natural mental maturing is given us.

Such an important investigation as Dr. F. Danzieger's of the 286 deaf mutes of the institution at Ratibor, Germany, deals as the title shows, specifically with malformations of palate and its relation to nose, eye and ear defects, but in general it canvasses the characteristics of the family medium into which deaf children are born—the prevalence of deafness in the blood relations and the diffused neuropathic tendencies of the near-of-kin. It may be described as a study which is largely taken up with a discussion and comparison of groups of deaf children with one another and not of deaf children with hearing children. These groups are divided on the basis of the casual factors of deafness and also more or less upon the time of appearance of the affliction.

*L'Annee Psychol. (1906), Vol. 13; p. 128.

**Dr. F. Danzieger, "Die Missbildungen des Gaumens und ihr Zusammenhang mit Nase, Auge, u. Ohr." Wiesbaden, 1900.

A COMPARISON OF DEAF AND HEARING BOYS OF CHICAGO AND PARIS.

Features examined		10 years			12 years			14 years		
		Deaf	Hearing	Per cent which deaf is of hearing	Deaf	Hearing	Per cent which deaf is of hearing	Deaf	Hearing	Per cent which deaf is of hearing
Height		mm.	mm.		mm.	mm.		mm.	mm.	
	Chicago ...	1335.4	1330.3	100.4	1370.2	1418.9	96.5	1528.1	1547.4	98.9
	Paris	1243.0	1340.0	92.7	1310.0	1370.0	94.9	1430.0	1510.0	94.7
Weight		kgs.	kgs.		kgs.	kgs.		kgs.	kgs.	
	Chicago ...	28.18	29.3	95.8	30.4	35.6	85.3	40.09	44.7	89.5
	Paris	27.47	31.00	88.6	32.24	33.0	97.9	39.17	41.0	95.5
Lung capacity		cu. cm.	cu. cm.		cu. cm.	cu. cm.		cu. cm.	cu. cm.	
	Chicago ...	1466	1659	88.3	1704	1956	87.1	2171	2527	85.9
	Paris	1000	1670	59.8	1190	1800	66.1	1741	2030	85.7
Circum. of Head		mm.								
	Chicago ...	527	.....	.....	521.2	.....	.....	539.3	.....	.....
	Paris	508	521	97.3	519.0	533	97.3	529.0	533	99.2
Hand grip	Chicago	kgs.	kgs.		kgs.	kgs.		kgs.	kgs.	
	R. H...	19.5	17.7	108.0	21.7	22.4	92.4	28.9	30.4	95.0
	L. H...	17.8	16.6	107.0	20.7	20.6	100.0	28.5	28.04	101.8
	Paris									
	R. H...	12.87	17.5	73.5	17.5	21.12	82.8	23.66	25.45	92.9
	L. H...	13.37	17.0	78.6	16.6	19.5	85.1	23.0	21.18	95.4

The direct comparison of the Deaf and Hearing Boys of Chicago and Paris, as well as the relative standing of the Deaf as compared with the Hearing can be easily read off in the Table.

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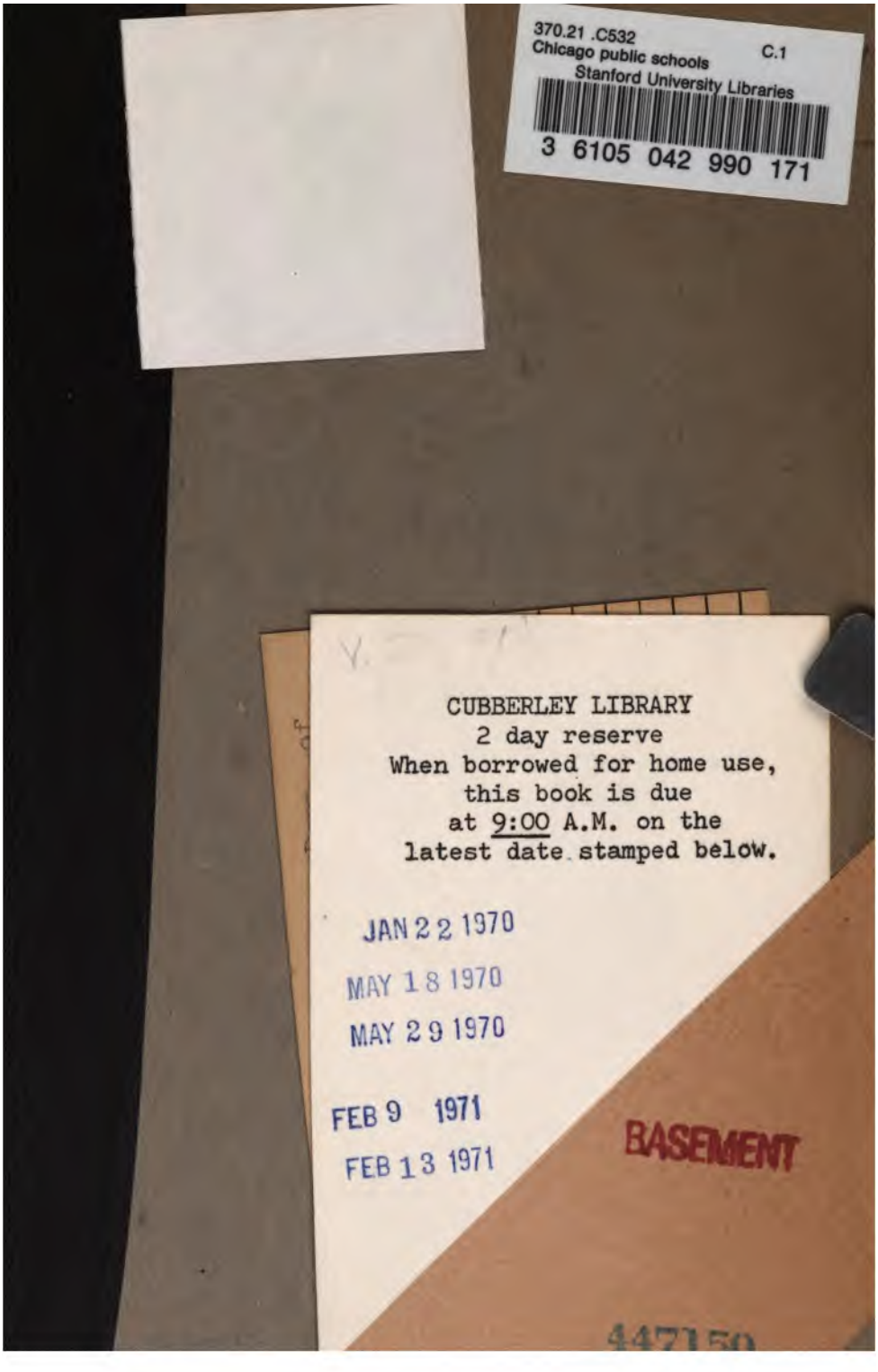
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